BIOMASS POTENTIAL ASSESSMENT FOR LOCATING BIOREFINERY PLANT IN HUNGARY

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ABSTRACT

To find a suitable site for a 150,000 metric ton dry material per year (t dm/yr) input capacity biorefinery plant in Hungary is a challenging task. Not only biomass potentials have to be assessed, competing uses, sustainability aspects, public opinion and future threats to feedstock availability should be also taken into account. As a result of our calculations, currently there is enough feedstock available for the targeted input capacity to operate in an ecologically sustainable way. However, several factors may threaten the future of feedstock availability. In the long run enhanced price competition is anticipated for biomass among biorefinery, livestock keeping, timber industry and biomass based renewable energy production. The majority of stakeholders accept in general biorefinery as a promising solution for substituting fossil based plastics, still local interests give priority to a balanced agricultural production including higher shares of husbandry.

Keywords: bioenergy, biomass potentials, biorefinery plant, planning approaches, sustainability

1. INTRODUCTION

Life cannot be imagined without the use of biomass and bioenergy even in today's modern societies. Fossil energy is only a temporary substitute for biomass in developed countries where its sources contributed to a great extent to food production during the era of industrialization in agriculture [8, 20]. Beyond food provision, biomass is increasingly becoming important again from energetic point of view:, being one of the most cost-efficient and most easily available resource. The energetic use of biomass also has significant share (60-90%) in developing countries [21].

Modern energetic use of biomass has long traditions in Hungary, as well. Roughly one million metric tons of firewood per year is burnt by households in the country. Since 2003 several power plants in Hungary have shifted from coal powder to biomass chips firing to produce electricity using 1.425 metric tons of wood annually, of which 1.3 million metric tons originate from woodlands [17, own calculation]. The energetic efficiency of using biomass this way is only 20-25% as waste heat is not utilised in most of the cases. Apart from food, energetics and timber (e.g. furniture) industry, biomass is also an increasingly important input for biorefinery and bioplastics with the aim of trying to substitute conventional petrochemical products whose price is continuously rising. Available biomass is increasingly used for all three purposes (food, energetics, material) inducing enhanced competition in the future. The significance of biomass remains and will continuously grow in all fields in our economies. This fact underlines the utmost importance of sustainable use as biomass can be considered renewable resource only among certain circumstances; otherwise complete devastation of the resource and related wildlife communities is a real threat. Biomass as a resource is embedded in the natural environment with thousand links and its excessive exploitation induces a domino effect of decay in related ecosystems [12].

It is a timely issue to evaluate the above uses according to efficiency in order to set a priority list that puts first the possibly most efficient use from environmental, social and economic aspects alike. Important principles to be considered include the waste management pyramid and the application of cascade systems in integrated biomass use [11]. For this very reason the use of biomass should be planned more carefully compared to other renewable resources (e.g. solar or wind power), where the principles of sustainable use should be respected in particular.

The objective of this paper is to present the critical points of biomass use and deliberative planning based on the example of a case study in Hungary. This case study is a biorefinery plant with a 150 t dm/year input capacity able to use feed-stock of hard wood and straw. The plant converts these raw materials to sugar based intermediaries, a basis for polymerisation into cellulose bioplastics like polyesters, polyethylene or other end products. As the material use of biomass is gaining increasing importance, we investigate questions of locating the biorefinery based on feedstock availability. We describe in depth the steps of planning related to choosing a proper feedstock mix that is available in a sustainable manner to ensure continuous feedstock supply. The paper begins with exploring the planning methodology from

literature. In the second part the results of the case study are presented in detail. In the third part of the study the applicability of the results is evaluated and discussed from the aspect of sustainability.

2. METHODS

2.1. Planning approaches

Investments are usually proceeded by careful planning. The major share of planning is related to creating the technical infrastructure and profitability calculations of the operations. In terms of developments in renewable energy production, and for investments in biomass use in particular, planning of sustainable feed stock supply is an important issue. In the event of a complex use of renewable resources an even wider aspect for planning is needed, as beyond technical and economic parameters social acceptance also emerges as an issue, since the negative effects of technologies that transform the environment are rather perceived by the local society. Consequently, these groups are steady opponents to investments with disadvantageous local effects and very often manage to thwart them [6].
The three dimensions of the scale along which planning approaches can be characterized are content, goal and the planner (Fig. 1).

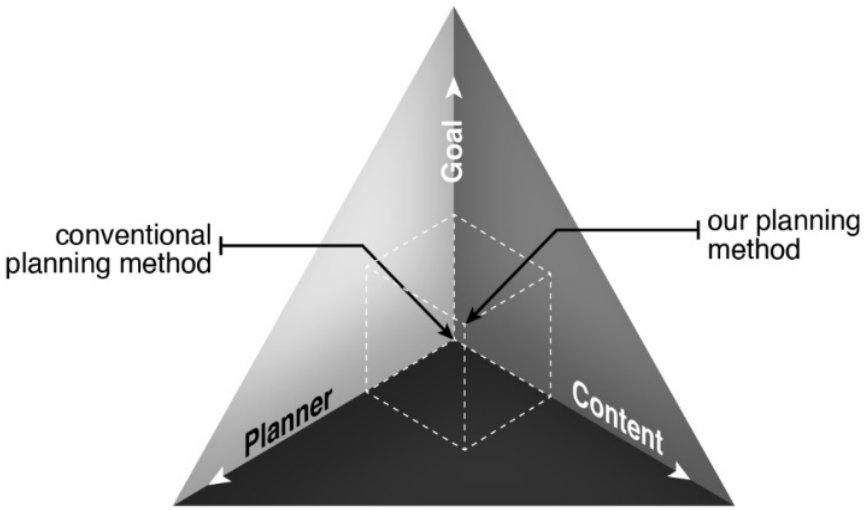

Figure 1. Three dimensions of planning approaches

The content of each plan can be very different and also dependent on the goal of planning and the personality of the planner. The goal of planning can be oriented for profit generation in contrast with the non-profit operation prioritizing self-supply. In order to have an open and innovative planning atmosphere, the group of planners should not be consisted of a narrow group of technical people. Additionally, concerned stakeholders shall be involved in the process. There are several levels of involvement [2] of which partnership or civil control is the real level of co-operation.
On the one end of the scale is when the plan prepared by a group of experts (planner axis) is purely concentrating on the technical and economic parameters (content axis), whose primary aim is to produce the investors' profit (goal axis). In this case the planner tries to find an optimal location for investment chiefly from economic aspects while meeting the local demands or striving for self-supply is not part of the concept. In this case the overexploitation of local resources (both natural and human) is not a direct threat to the planned investment as after depletion of resources the plant is moved to a new site in the next resort.
In contrast, on the other end of the scale is the community based participatory planning approach with holistic view on integrating environmental, ecological and social aspects, where profit is secondary and economic issues are handled at the level of covering costs (goal axis). Autonomy is a central element to this planning approach that prioritizes the demands of local community over production for sale (content axis). The planning process is bottom-up and involves the local community that participates actively and decides about the investment and its scales (planner axis). Such investment and operation will then be

inherently linked to local resources. Any risk or damage to the local resources will threaten the investment as well, so there is direct feedback between the investment and its environment.
Between the above described extremes there is a series of transitional approaches. The reason for this – concerning the content axis – is that renewable energy production investments planned purely on business aspects are not capable of accommodating to the natural and social environment, therefore, their operability in the long run is uncertain. On the other end – concerning the goal axis – no purely autonomy-based planning mechanisms appear in reality as cost-efficiency is important also with community investments. In many cases it is not even about self-supply as some local demands cannot be met solely based on own resources. Such demands must be fulfilled through import with the help of merchandising the extra local production (for example buying fuel for the surplus of produced green electricity).
Planning involves three main aspects: planning of available biomass potential, estimating the environmental effects and setting the optimal location. In this study we considered only the available biomass potential planning.

2.2. Biomass potentials

There are several approaches to calculating biomass potential. The largest amount is usually called total biomass potential which is calculated on the basis of the total annual production and which also involves the amount of by-products and waste produced (Fig. 2). This potential is called physical or theoretical biomass potential [25]. In this relation by-products and waste are categorized as primary (produced by agriculture), secondary (produced during the processing of agricultural raw materials) and tertiary (produced during consumption).

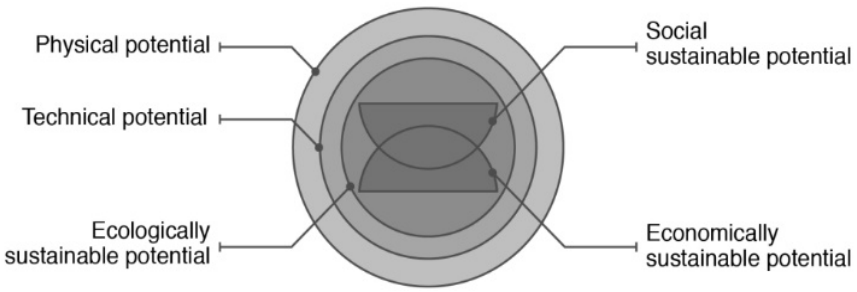

Figure 2. Different types of potential and their relations

The next category is the technically available biomass potential, that involves the harvestable amount of biomass with regard to the technical specifications. This is calculated in the literature in various ways [25]. Ref. [5] defines technical potential as the amount remaining after the demands of competing uses are deducted from the total. Beyond biomass use for industrial and food purposes, environmental and ecological demands also belong to competing uses. In contrast, according to Ref. [25], the technical potential means the amount of a certain type of energy (e.g. thermal energy, biofuel or electricity) that can be produced from the available raw material with the technology in question.
The third type is available potential given by the volume of available amount of biomass that can be collected with regard to both technical and economic aspects [25].

2.3. Methodology

Our study is more than about planning the technical and economic aspects, as potential environmental effects are also considered. The aim of planning is also more than merely seeking for profit, as the planned technology on the one hand will enable the substitution of fossil resources and will also give opportunity for the realization of a more efficient cascade type [11] use of biomass. Local meetings were organised in the target area to collect opinions about the development. Although they did not take part in the full planning process itself, they were involved in a very early phase of the planning process when concrete data on the planned production details were not yet available. We locate our planning approach in Fig. 1 compared to the profit oriented conventional planning, which is in the origin, more or less to an equal

distance from the origin in each direction highlighting the diversity of goals, planners and the broader focus of content.

Based on the above biomass potentials we devised the following methodology. As a first step the physical potential was calculated. This involves the total amount of biomass that can be produced in the given study area and can be used by the given technology.

From the physical potential the technical potential is determined that involves the harvestable amount of biomass with regard to the technical specifications. The losses during harvest (e.g. height of stubble during straw harvest) and technical collectability of biomass should be considered. In the next step the available biomass potential is calculated from the technical potential by deducting the demands of competing uses in the area, such as bedding straw demand of animal husbandry and firewood demand of heating- and power plants, etc. Finally, it is necessary to investigate whether the full exploitation of the available biomass is sustainable from environmental, economic and social aspects [25, 23]. The workflow for defining the available sustainable potential is depicted in Fig. 3.

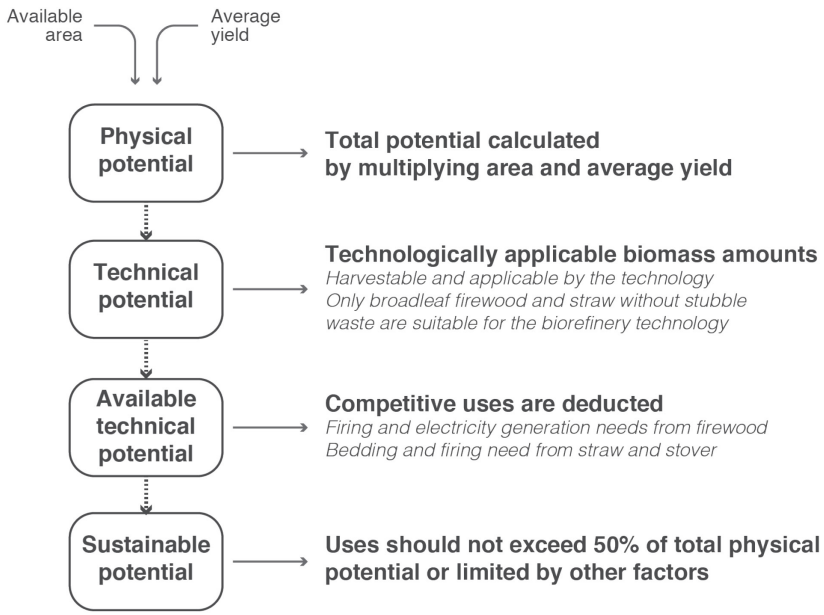

Figure 3. Methodology for defining the available sustainable potential

In terms of ecological sustainability it is an evitable question how much biomass can be consumed by the society without harming the concerned ecosystems. This can be assessed with the help of the Human Appropriation of Net Primary Production (HANPP) model (Haberl et. al. 2004), or more precisely with one of its components, the net primary product (NPP_t) that involves the amount of biomass remaining for natural ecosystems beyond human use. This is the amount of energy flow that is available for the normal functioning of natural ecosystems. The minimum of NPP_t means that any further decrease in this amount would lead to the damage and shrinkage of ecosystems [27]. For the detailed introduction of the method see [11].

According to Ref.[12] the value of NPP_t shows positive correlation with species diversity. The study suggests that a HANPP value over 50% might lead to biodiversity decline [12]. The HANPP was 49% in Hungary in 2005 meaning that out of the net primary product (NPP) produced by autotrophs 51% (NPP_t) remained for natural ecosystems [14]. Consequently, any further take-out from the flow will reduce the energy available for natural ecosystems and increase the pressure on them. Thus, planning should be very careful if we are about to exploit new sustainable biomass resources.

The equation below defines the sustainably available potential:

$$sustainable\ potential = physical\ potential \cdot (0{,}5\ or\ other\ determinants)$$
$$available\ technical\ potential = technical\ potential - competitive\ uses$$
$$sustainable\ available\ potential = sustainable\ potential \cap available\ potential$$

Following the methodology in the first step, the task was to select the target area (Fig.4). To this end the area of arable and woodlands from the Corine Land Cover 2006 database was selected to each county, and legally protected and EU protected Natura 2000 areas were deducted (Tab. 1). The first selection criterion was the area of forest as the most favourable raw material for the biorefinery is deciduous wood. Therefore we wanted this resource to be planned with the possibly highest share in the input mix. Then we chose the four neighbouring counties (Baranya, Somogy, Tolna and Zala) with the largest area of woodland and arable land to reach the largest physical potential possible. These four counties were further analysed. In order to get the physical potential the average yield were determined both for forest and straw and multiplied by the available area.

Table 1. Detailed land use data of the target region

	Arable land (ha)	Share of arable land (%)	Forest land (ha)	Share of forest land (%)
Not protected	840 080	95,07	252 143	54,94
High Nature Value (HNV) Area	12 962	1,47	0	0
Natura2000	21 403	2,42	131 002	28,54
Protected	2 510	0,28	1 221	0,27
HNV+Natura2000	579	0,07	0	0
Protected Natura2000	5 450	0,62	74 583	16,25
Protected HNV	97	0,01	0	0
Protected HNV + Natura2000	572	0,06	0	0
Total	883 654	100,00	458 948	100,00

Based on forestry data [18] the annual yield of woodlands was calculated, of which only the firewood share was considered. To determine the average annual amount of the total yield the 5 year average of forestry yield was used since the production from year to year is not even. The other group of raw materials is straw and corn stover. The physical potential can be calculated by multiplying the total harvested yield [15] with the grain-stalk ratio of the corresponding crop [1,24]. To eliminate the fluctuation in annual yields we took the 3-year average in the calculations.

In the next step we calculated the technical potential. The technical potential of wood was calculated by considering only hardwood (i.e. broadleaf) fraction of the physical potential. We estimated the share of firewood in the total yield to be 60% and supposed that all of the broadleaf fraction of firewood is harvestable. Considering the 40% moisture content of the expected yield we calculated the yield in dry matter. This technical potential is supposed to be equal to the ecologically sustainable potential as the forestry yield plans are developed according to sustainable management principles. To get the technical potential the straw amount remaining on the stubble was deducted from the physical potential. The amount of stubble straw was calculated from the estimated 10 cm stubble height and the grain-stalk ratio of the corresponding crop (Tab. 2) provided that the consistence of the stalk is the same along the whole length.

Table 2. Straw waste ratio of different crops [24]

	Length of stem (m)	Height of stubble (m)	Waste ratio (%)	Sustainable harvestable share (%)
Wheat	0.90	0.10	11%	33%
Rye	1.80	0.10	6%	33%
Triticale	1.50	0.10	7%	33%
Maize	2.00	0.10	5%	33%
Sorghum	2.00	0.10	5%	33%

After the calculation of the physical and technical potential the next step is to determine the available technical potential by deducting biomass demands of competing uses from the technical potential. Here we considered all industries and households that use the same resource (Fig. 4). Consequently, the district heating units for instance in the study area would supply their fire wood demands from the above calculated technical potential. In the case of straw both the demands of energetics and bedding straw were deducted in our calculations.

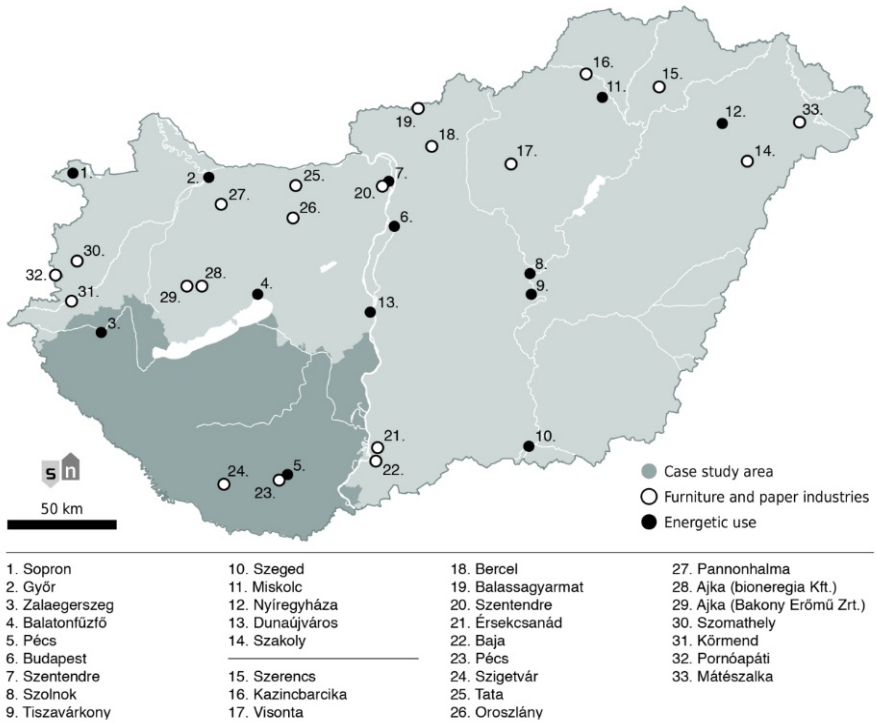

Figure 4. Case study area and biomass firing units and biomass utilization factories in Hungary

The bedding straw demand was calculated from the following parameters: number of animals in the study area [15], daily bedding straw demand specific by livestock type [19] and number of days of bedding [13] (Tab. 3).

Table 3. Bedding needs of selected livestock [13, 19]

Livestock	Mode of housing	Average bedding need (kg/LSU/day)	Bedding days per year (day)
Cattle	free litter	6.0	185
	bounded litter	3.0	185
Pig		6.0	365
Sheep		7.0	125
Horse		4.5	185

Having deducted the demands of currently competing uses from the technical potential the available technical potential is given. The calculation, however, raises a few problems and requires some assumptions to be made. It cannot be explicitly determined to what percentage the technical potential in question is present and how it is changing over time in the portfolio of a certain competing use. Moreover, it is not possible either to identify what percentage of biomass demand of a certain competing use originates from the target area.

To minimize the effects of the above uncertainties the following assumptions were made:

1. The biomass quality and quantity equal to the technical potential calculated from the known part of the portfolio of competing uses is entirely used by the competing plant. This assumption also means for the

economic potential that the competing uses can pay at least the same price for the raw material, i.e. the competing plants are at least in the same economic position as the planned biorefinery.

2. The competing plants gain their raw material supply 100% from the study area.
Since in determining the ecologically sustainable potential of straw and stover production the soil organic carbon (SOC) content is one of the most important criterion, the sustainability criteria for straw and stover were fine-tuned by considering requirements for SOC maintenance. The SOC reduction is 0.27 t C/ha/year for straw and 0.35 t C/ha/year for corn stover, when they are harvested [3]. Ref. [22] also proved the explicit decrease in SOC when corn stover is removed from site. At the same time there is considerable increase in SOC when the stover residues are left on the field. Thus, in order to maintain the SOC we calculated only with 33% of the total straw and stover harvest as residues left on the stubble increase the SOC to a higher degree than the degree of reduction caused by harvesting these by-products [22]. As a result, this calculated amount was considered a sustainable potential.
Another important factor is the fertilizing effect of straw ranging from 1.5-4.5 kg N/t dm [3] that on the other hand may reduce the environmental effect of chemical fertilizers produced with fossil energy if it is reincorporated into the soil. On the other hand, the decomposition of the straw increases GHG emission [3]. These factors, however, were not considered in our calculations.
After deducting the demands of competing uses the available potential is the result. The intersection of the available technical potential and sustainable potential gives the category of biomass that can be sustainably used for biorefinery purposes in the target region, i.e. the sustainable available potential.
The third source of raw materials is from short rotation coppice (SRC). The physical potential of this source was calculated from the area of current plantations (3748 ha) and average yield [9]. The average annual yield was considered in dry matter (9 t/ha) with supposing 40% moisture content.
Of the ecologically sustainable biomass potential we consider an amount socially sustainable whose quantity and nature of use is acceptable for the concerned community. The socially sustainable potential can only be determined if local inhabitants are involved in the planning process. The optimal level of public participation is therefore decisive from the viewpoint of social sustainability.
The final category is economic sustainability. This involves an economic and profitable production that should be sustainable from ecological and social aspects at the same time. In the concept of strong sustainability [7] resources are not substitutes for but rather complementary to each other.

3. RESULTS AND DISCUSSION

3.1. Feedstock potentials

The plant is able to take woodchips from broadleaf forest and SRC with a minimized fraction of bark. Additionally, straw and corn stover can be processed too.
Based on the methodology described above, the calculation of the physical potential of the broadleaf wood supply on an area of 408,718.4 ha yields almost 2.1 million m^3 wood/yr with 40% moisture content equalling to 843,416 t dm wood/yr. Determining the harvestable technical potential the firewood share of the physical potential was calculated that is 506,050 t dm firewood/yr. Deducting the competitive uses like power plant, district heating and households (altogether 470,510 t dm/yr), it turns out that the available technical potential of broadleaf forests is 35,540 t dm firewood/yr.
In the case of the next feedstock (straw and stalk) first also the physical potential was calculated, where 15% of moisture content was considered. It gives then the total amount of harvested straw (3,7 million t dm/yr). Deducting harvest wastes we gain the technical potential of 3,4 million t dm/yr. When subtracting the competitive uses of firing, bedding for animal husbandry and the necessary amount of sustaining SOC (2/3 of the physical potential), the available technical potential shrinks to 0.66 million t dm/yr.
In the case of SRC poplar the current cultivation area is not sufficient to cover the share of the biorefinary demand, an extra 8.856 t dm is needed. This amount considering a two years rotation can be cultivated on 1970 ha which requires a rather large land transformation from conventional cultivation, in the short run this deficit could be covered by straw and stover.
The feedstock input of the plant has been standardized for planning reasons, however, the portfolio is defined according to the available feedstock. In the target region, since the highest share of the technical potential is given by straw and corn stover, 60% of the feedstock is from these reources, 20% is firewood and 20% stems from SRC plantations, mainly poplar.

Considering the demand of the plant in the given 60-20-20% portfolio, the target region can provide the necessary amount in the given feedstock, with straw being the most abundant resource. The results are summarized in Fig. 5.

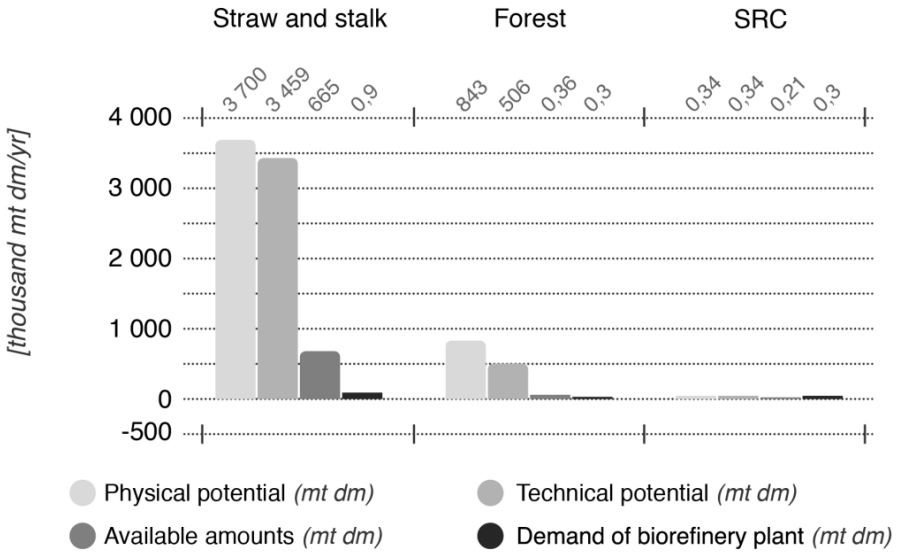

Figure 5. Available potentials

To assess the ecological effect the HANPP model was used. According to the previous calculations for Hungary the net primary production (NPP) is 13.3 MJ/m^2/year for forests and 9.2 MJ/m^2/year for grasslands [14]. In the case of forests this equals to 7,2 t DM/ha/yr NPP if 18,5 MJ/kg dry matter energy content is assumed [16]. When considering the total forest area in the target area and the total average yield (Tab. 4) from the forestry database, the HANPP is 28%. This is a favourable value when compared to the 50% assumed sustainability ceiling. If the planned plant will not use more firewood than the permitted felling of the forestry management plans, then the use of this source can be considered sustainable.

Table 4. Results of HANPP calculations for forest

Forest average productivity (t dm/yr)	7.2
Total forest area (ha)	458 950.8
Total forest production (t dm/yr)	3 299 484.1
Total harvest (t dm/yr)	917 854.8
Share of harvest (%)	28

In the case of arable lands the calculation of above ground NPP_0 (NPP_0: NPP of the potential terrestrial vegetation) is a result of the total harvested yield and the stover residues (NPP_h:NPP harvested or destroyed) [14]. The total of grain and straw is 5.7 million t dm, from which the total grain volume and the current and planned uses of straw (Tab. 5) mean the consumption. The harvested grain and straw is 47% of the total yield which is very close to the sustainability limit (50%).

Table 5. Results of HANPP calculations for straw

NPP_0 (t dm/yr)	5 691 906
NPP_h corn (t dm/yr)	1 991 276
NPP_h straw (t dm/yr)	702 208
Share of harvest (%)	47
Total straw need (t dm/yr)	702 208
of which	
bedding need (t dm/yr)	372 208
power plant (t dm/yr)	240 000
biorefinery (t dm/yr)	90 000

3.2. Results of the stakeholder meeting

In order to focus on the social acceptance and gather local knowledge from expertise, a stakeholder meeting was held. The results of the stakeholder meeting are as follows.
Uncertainty stems from the high variability of yields due the high diversity of cultivation conditions in the target region futher mitigated by unexpected weather effects. The target area is a hilly region, thus the available area for energy plantations is limited. Not just elevation but related water shortages can also hinder successful cultivation.
Forests in Zala county have the best conditions and highest yields in Hungary. The target region has a total yield of approx. 1 million m^3. Forest cover in the target region reaches 25 %. Although, a considerable amount of the forest harvest, especially from Zala, is exported to Austria. Here, the accession of Croatia to the EU also creates an extra demand. Additionally, common property forests are impossible to manage which again reduce the production potential. Around the power plant in Pécs with a diameter of 50-70 km it is impossible to find enough feedstock because the plant collects all available materials. The weak road network is also a limiting factor.
Stakeholders stated that it is rather problematic to cover the straw demand necessary for the power plant within the four counties that are identical with our target region. Here transportation impossibilities also excluded some available feedstock.
Concerning straw demand, with the planned biorefinery industry there is not much space for future growth in animal husbandry which has been dwindling activity until very recently. However, there are strong political initiatives that intend to reverse this trend and to establish a more balanced relation between plant production and animal husbandry. There are already signs in the target region that the number of animals will be increased considerably (by hundred thousand in the case of cow and swine), which will require a higher share of the straw than it is available currently.
The planning approach has been criticized by stakeholders for still being a top-down driven approach neglecting local demands, as their aim is market-oriented agricultural production.
A 150,000 t dm/yr input sized plant seems to be too large for the region.
There are additional competing uses emerging in the region (pellet and briquette production in Belezna, Kapuvár and other settlements in Bakony, biomass power plants in Gellénháza, Nagypáli, and an additional straw firing unit in Söjtör). The realization of these units will further shrink the possibilities of the planned biorefinery plant.
The majority of stakeholders accepts the biorefinery as a promising solution for substituting fossil based plastics; however, a balanced agricultural production including higher shares of husbandry is considered to gain priority. As a result, smaller refinery units adjusted to local demands and sustainable feed-stock potential should be a more acceptable alternative.

3.4. Sensitivity analysis

In order to incorporate stakeholders' opinions we developed an extreme scenario, where two important negative effects are considered: growth in bedding needs of an expanding husbandry sector and yield fluctuations due to weather extremes.
The recent statistics (2010) of livestock is irrationally low, it does not reach half the value of the year (1988) when it was the highest in the last 100 years. If we assume that the number of current livestock will

increase and reach the level of 1988 (as a maximum), then it means a 250% change to cattle, 262% to pigs and 187% to sheep numbers. As a result, the bedding straw demand will increase from 370,000 metric tons to 947,000 tons.

Climate change is a further uncertainty factor. Both drought and floods can substantially reduce expected yields. However, due to elevation characteristics the effect of floods are negligible in the target region, only drought is a threatening factor.

No forecast data were available for the degree and frequency of drought and its effects on yield. Therefore, a series of yield data from previous years and historical data of yield decreases in years of drought were used to create a worst scenario. The yields in years with drought (2003, 2007) were assumed for 2025 that means 26-43% reduction in yield depending on crop. Assuming this extreme effect by 2025, 26% yield loss in cereals and an average 43% yield loss in corn is expected. We also assume that the amount of straw and stover is decreasing to the same degree as grain loss. Similar calculations for forestry, due to data shortage, could not be carried out.

This yield loss together with the increase in animal numbers will modify the available biomass potential as shown in Fig. 6.

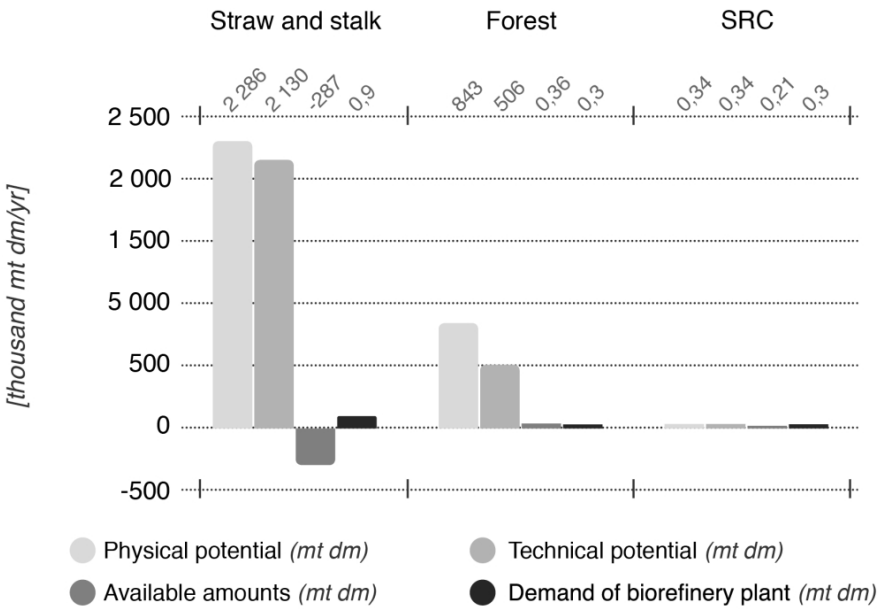

Figure 6. Available potentials according to the worst case scenario

It is apparent that the raw material previously available in the largest quantities will diminish due to the anticipated changes and will not be able to meet even a 90,000 t/yr of straw and stover biorefinery demand. Consequently, the demand and competition will increase for the available firewood and the ratio of feedstock sources would have to be modified from the currently planned 60:20:20. As a result, the quantity of firewood would also drop to a minimum, and pressure increased on the still protected forest and arable land sites. Additionally, the criteria of sustainable production might also be violated more frequently, like collecting more straw and stover than 33% of the total harvest. The situation could be improved if the area of energy crops was increased but this might be limited by the increasing needs for food and fodder.

4. SUMMARY

We conclude that among current circumstances, and with the necessary development of SRC envisaged, there is enough feedstock for a 150,000 metric tons dm/year input capacity biorefinery plant. In the feedstock portfolio 60% is straw and corn stover, 20% is firewood and 20% stems from SRC plantations, mainly poplar.

Future changes, however, may substantially overwrite the picture of the currently abundant feedstock.

Forestry yield loss due to drought is a main threat to broadleaf feed stocks but increase in demands from other sectors for certain forestry categories is also foreseen. Uncertainty also stems from the high

variability of yields due the high diversity of cultivation conditions in the target region further exacerbated by unexpected weather effects and climate change. The target area is a hilly region, thus the available area for energy plantations is limited. Not just elevation but related water shortages can also hinder successful cultivation.
Additional competing uses are also emerging in the region (pellet and briquette production, biomass power plants, straw firing units) and also encouraged by national initiatives (e.g. to reverse the recently diminishing trend of livestock husbandry) which also put pressure on straw as feedstock availability in the long run.
Although the planning approach was still criticized by stakeholders to be top-down driven, the majority accepts biorefinery in general as a promising solution for substituting fossil based plastics. As a result, a balanced agricultural production including higher shares of husbandry and market-oriented agricultural production as local aims are to be given priority. Consequently, a smaller refinery units adjusted to local demands and sustainable feed-stock potential shall be a more acceptable alternative.

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BIOSYNTHESIS OF XANTHAN GUM ON WASTEWATER FROM CONFECTIONARY INDUSTRY

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ABSTRACT

Xanthan gum is one of the major commercial biopolymers employed in many industrial processes owing to its unique physical properties such as a high degree of pseudoplasticity and high viscosity even at low concentrations. Commercially available xanthan gum is relatively expensive due to glucose or sucrose being used as the sole carbon source for its production and cost reduction could be achieved by using less expensive substrates, such as food industrial wastewaters. Effluents from the confectionery industry, because of its high organic content, are significant environmental pollutants and before their release into environment it is necessary to purify them. The present study examines xanthan production by *Xanthomonas campestris* under aerobic conditions on wastewaters from five different factories of the confectionery industry. Xanthan yield was obtained as a quantitative characteristic of the process and was in the range between 4.28 g/L and 10.03 g/L and its quality is determined by following rheological characteristics of obtained cultivation media. The results obtained in this study indicate that wastewater from confectionary industry can be used as the basis of media for the production of this highly valuable product.

Keywords: xanthan, wastewater treatment, biosynthesis, sucrose

1. INTRODUCTION

Xanthan gum is an extracellular heteropolysaccharide discovered in the late 1950s and is the first biopolymer produced industrially. It is synthesized by gram-negative phytopathogen bacterium X*anthomonas. campestris* and represent an attractive alternative for the replacement of traditional gums obtained from plants and marine algae (Jeeva et al., 2011). Xanthan solutions are highly viscous even at low concentrations and display a pseudoplastic, or shear thinning behavior, stability and compatibility with most metallic salts, excellent solubility and stability in acidic and alkaline solutions and resistance to degradation at elevated temperatures and various pH levels (García-Ochoa et al., 2000; Faria et al., 2011). It is a widely used biopolymer in the food and pharmaceutical industries, as well as petroleum production, pipeline cleaning, enhanced oil recovery etc. (Sutherland, 2001).The cost involvement with the fermentation media represents a critical aspect for the commercial production of xanthan due to glucose or sucrose being used as the sole carbon source (Mudoi et al, 2013).

Confectionery industry generates high amounts of wastewater which contains high concentrations of readily biodegradable organic materials characterized with high COD and BOD (Ersahin et al., 2011). The main characteristic of xanthan biosynthesis is non-specificity of carbohydrate substrate, which is why wastewaters from the food processing industry can be used as the basis of media for this bioprocess. In this way, environmental pollution is reduced, as well as cost of xanthan production.

The aim of this study was to examine the possibility of xanthan production with *Xanthomonas campestris* by conversion of organic compounds from confectionery industry wastewaters obtained from different parts of the production processes of five different factories on the territory of Vojvodina.

2. MATERIALS AND METHODS

2.1. Materials

Production microorganism
As a producing microorganism the reisolate of a referent culture Xanthomonas campestris ATCC 13951, labeled as A-1, was used for experiments.

Cultivation media
Wastewaters from five different factories of confectionery industry located in Vojvodina (marked as CW1 to CW5) were used as cultivation media for the production of xanthan. All wastewaters were first analyzed

to determine initial carbon and nitrogen content and on the basis of obtained results all cultivation media were enriched by addition of sucrose, so that the initial concentration of the carbon source is 1.5%. As a nitrogen source, yeast extract and (NH4)2SO4 (in 2:1 ratio) were added, so that the total nitrogen content is 0.02%. Also, 0.05% MgSO4·7H2O and 0.25 % K2HPO4 were added and the pH value of the cultivation media was set to 7.0 and sterilized in an autoclave at 121°C and overpressure of 1.1 bar during 20 min.

Cultivation

The inoculation of cultivation media was performed by adding 10% of inoculums prepared in two steps - first, by refreshing the culture by incubation for 24h at 28°C and second, by double passage of microorganism on the synthetic YMB media (containing: 1.5% of glucose, 0.3% of malt extract, 0.3% of yeast extract and 0.5% of peptone) for 36h, at 28°C. Samples were spontaneously aerated and externally mixed (laboratory shaker, 150 rpm). The biotechnological process of xanthan production was carried out under same experimental conditions in five Woulff bottles, containing 1,500 mL of media. Cultivation was carried out under aerobic conditions (air flow rate of 0.01 L/L·min in the first 48 h, and 0.02 L/L·min afterwards) and with external mixing at conditions mentioned above. In the first 48 h, the cultivation temperature was 28°C, after which it was increased to 30°C. The total time of cultivation was 120h. Regulation of process parameters was done in accordance with the literature data (Rosalam and England, 2006).

Product separation

Biosynthesis was stopped after 120 h and the cultivation broth was centrifuged at 10.000·G for 10 minutes (Eppendorf Centrifuge 5804). Ethanol (minimum 96%) was gradually added to the obtained supernatant until it had a content of 60%, while constantly being cooled in an ice bath and mixed with a laboratory stirrer (UM-15, Tehtnica, Železniki). A saturated solution of KCl was added when half of the ethanol was poured into the cooled supernatant, until it had content of 1%. The temperature of the mixture did not exceed 15°C. After precipitation the mixture was kept at 4°C for 24h in order to dehydrate the precipitated xanthan. The final step of xanthan separation was to centrifuge the mixture (3500 rpm for 15 minutes) on a centrifuge (LC-320, Tehtnica, Železniki). The precipitate was dried to a constant mass on 60°C and this data was used to calculate the xanthan yield.

2.2. Methods

The course of biosynthesis was monitored every 24 h by analyzing the samples taken from the cultivation broth. The separation of solid and liquid phases in the cultivation broth samples were carried out by a centrifuge at 10.000·G for 10 minutes (Eppendorf Centrifuge 5804).

Reducing sugars content was determined indirectly based on the content of sucrose hydrolyzed with the addition of ccHCl (100°C, 5min) and neutralizated with 5N KOH, in the supernatant of the cultivation broth by the method according to Miller (1959). Total nitrogen content was determined by the Kjeldahl method (Herlich, 1990). A rotational viscometer (REOTEST 2 VEB MLV Prüfgeräte-Verk, Mendingen, SitzFreitel), with a double gap coaxial cylinder sensor system, spindle N, was used for determination of rheological properties of the cultivation media samples. Volume of samples was 10 ml. Based on deflection of measuring instrument, α (Skt) under defined values of shear rates shear stress, τ (Pa) was calculated using the equation:

$$\tau = 0.1 \cdot z \cdot \alpha \quad (1)$$

Value of constant z (dyn/cm^2·Skt) is 3.08. According to the Ostwald de Vaele equation, which describes viscosity of pseudoplastic fluids, and calculated values of shear stress, rheological parameters were calculated.

3. RESULTS AND DISCUSSION

After determination of initial carbon and nitrogen contents in obtained wastewaters (Tab. 3) cultivation media were prepared to contain same amounts of these nutrients and all experiments were performed simultaneously, so that all stages of the biotechnological process would be carried out under identical conditions. Five cultivation media were examined for xanthan yield and sugar conversion in order

to determine the success of performed biosynthesis and obtained results are presented in Tab. 1. Based on the results in Tab. 1, xanthan yield, as a quantitative characteristic of the process, was highest in the CW1 media (10.03 g/L) and lowest in CW5 media (4.28 g/L). CW2 and CW4 media had similar values of xanthan yield (9.5 g/L), as well as sugar conversion (about 60%) and value of conversion of sugar into product (about 80%). Obtained results of xanthan yield were lower than the results obtained from literature for sucrose used as a basic sugar for biosynthesis (Leela and Sharma, 2000). Values of sugar conversion were in the range between 51.60 and 66.85%, which is in accordance with literature data (García-Ochoa et al., 2000) and only in the CW5 media this value is significantly lower and amounted 28.59%.

Table 1. Xanthan yield, sugar conversion and conversion of sugar into xanthan in enriched confectionery industry wastewaters after 120 h of biosynthesis

Media	Xanthan yield, P [g/L]	Sugar conversion(1) [%]	Conversion(2) [%]
CW1	10.03	66.85	79.87
CW2	9.43	60.84	83.55
CW3	7.74	51.60	76.20
CW4	9.60	61.94	79.81
CW5	4,28	28.59	54.67

(1) sugar conversion [%] = $(S_0\text{-}S)/S_0 \cdot 100$
(2) conversion [%] = $P/S_0 \cdot 100$

Even though used amount of sugars did not exceed 2%, the degree of conversion was lower than expected (Moraine and Rogovin, 1971) and this could be explained by the fact that cultivation media contained some substances that have an inhibitory effect on xanthan production. Also, increased viscosity of cultivation media leads to diffusional limitations due to reduced oxygen solubility and finally to lower xanthan production.

In applied experimental conditions quality of produced biopolymer was evaluated based on rheological behavior of obtained cultivation media. Graphical representation between shear rate and shear stress, flow curves, of all cultivation broths after 120h of biosynthesis are shown in Fig. 1. All samples represent a pseudoplastic type of flow, according to Fig. 1, as well as values of the flow behavior index (Tab. 2).

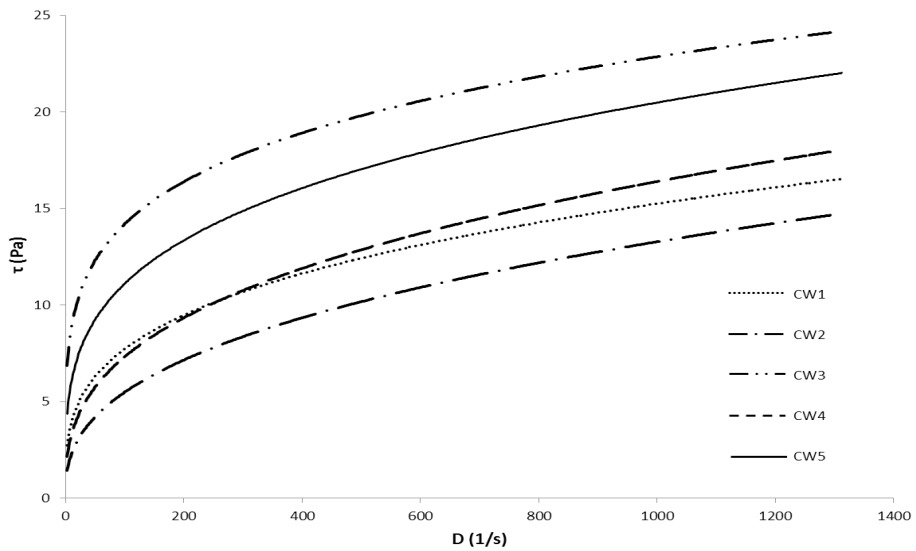

Figure 1. Shear stress as a function of shear rate in cultivation broths after 120 h of biosynthesis

Table 2. Rheological parameters and coefficient of correlation for cultivation broths after 120 h of biosynthesis

Media	K	n	R^2
CW1	1.9763	0.2958	0.99
CW2	0.9328	0.3844	0.98
CW3	5.4696	0.2070	0.99
CW4	1.4572	0.3504	0.99
CW5	3.2609	0.2660	0.98

Values of the consistency factor K (Tab. 2) indicate a different quality and quantity of synthesized biopolymer, given that viscosity and the consistency factor are proportional. Based on the values of the consistency factor it can be concluded that xanthan with the best quality is synthesized in the CW3 media while the low value of the consistency factor as well as the result of xanthan yield indicate that the CW5 media contained the lowest amount of xanthan with the lowest quality. Values of the flow behavior index, high value of the consistency factor and the results of xanthan yield suggest that the CW1 media contained the highest amount of xanthan with good quality.

In addition to producing a high value product, the aim of this paper was to examine the possibility of biological purification of confectionery industry wastewaters obtained from different parts of production processes, which was done by determining and comparing the contents of carbon and nitrogen before and after the performed biosynthesis. Considering the results shown in the Tab. 3 relating to the initial content of carbon in the wastewaters it can be seen that obtained values were significantly different. Initial values of carbon in the CW1 and CW2 media was less than 0.05 % while in the CW3, CW4 and CW5 media this value was significantly higher and amounts to about 0.8%. This can be explained by the fact that used wastewaters were obtained from the different factories as well as from different parts of the production processes before or after a certain purification treatment. After biosynthesis, values of carbon content decreased in all wastewaters by about 55% except in the CW5 media where this value was lower (about 11%) which is in accordance with results of xanthan yield, sugar conversion as well as conversion of sugar to xanthan in this media. Decrease in nitrogen content in the CW1 and CW3 media after biosynthesis of xanthan was about 15% while in the CW2, CW4 and CW5 media was around 50%.

Table 3. Comparison of carbon and nitrogen content in wastewaters before and after xanthan biosynthesis

Medium	$C^{(1)}$ [%]	$N^{(1)}$ [%]	$C^{(2)}$ [%]	$N^{(2)}$ [%]
CW1	0.0460	0.0035	0.0210	0.0030
CW2	0.0410	0.0042	0.0099	0.0021
CW3	0.9520	0.0112	0.3570	0.0098
CW4	0.7240	0.0070	0.313	0.0042
CW5	0.7710	0.0084	0.680	0.0050

(1) Content before biosynthesis
(2) Content after biosynthesis

4. CONCLUSION

In this study, the production of xanthan on five different confectionery industry wastewaters enriched with sucrose was examined. From the obtained results it can be seen that in the four out of five used wastewaters, the obtained yield is in the range between 7.74 g/L and 10.03 g/L while the conversion of xanthan was about 80%. In only one examined media these values were lower and were 4.28 g/L for xanthan yield and 54.67% for conversion of xanthan. Also, carbon and nitrogen content decreased in all wastewaters but not to a significant extent. Based on these results, wastewaters from the confectionery industry can be used as a basis of media for xanthan production, but further optimization of process is necessary in order to achieve higher yields and better purification of used wastewaters.

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CHARACTERIZATION OF POLYMER MEMBRANES BY CONTACT ANGLE GONIOMETER

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ABSTRACT

The wider applications of all membrane separation processes have a main obstacle, namely the fouling phenomena, which have to be understood in more details. Surface properties, hydrophilic and hydrophobic characteristics of a polymer membrane can be determined by measuring the contact angle. The hydrophilicity of a membrane has an important influence on its performances, like permeate flux, membrane rejection or membrane fouling characteristics.
In our work the contact angles of three kinds of typically commercial ultrafiltration (UF-PES-4), nanofiltration (NE-90) and reverse osmosis (LFC-30) membranes were firstly investigated and compared by contact angle goniometer measurements. The relationships between the contact angles were researched by well considering the effects of membrane sample pretreatments by distilled water prewetting and water droplet volume. Furthermore, the effects of prewetting, water droplet contact time on different molecular weight cut-off ultrafiltration membranes' surface and droplet pH on the contact angle values were also investigated. Moreover, fresh, clean and dry, as well as pretreated, and fouled UF membranes were also measured and compared.

Keywords: contact angle, goniometer, hydrophilicity, polymer membrane

1. INTRODUCTION

Membrane separations, microfiltration (MF), ultrafiltration (UF), nanofiltration (NF) and reverse osmosis (RO) have been extensively used in food industry for selective separation of different molecules and compounds. In these membrane processes the pressure difference is the driving force between the two sides of the membrane, therefore they are called pressure-driven membrane processes or membrane separation technologies. For example all of these mentioned processes have been in use in the dairy industry for about 4-5 decades [1]. However, they more widely industrial applications have a main obstacle, namely the membrane fouling or clogging. Fouling phenomena are necessary to understand it in more details. The surface properties of membranes can be characterized by measuring the contact angle. Membrane hydrophilicity or hydrophobicity characteristics can be determined by measuring the contact angles. Low contact angle indicates high water affinity and also, any change in the contact angle can indicate more fouling formation because of differences in surface properties of the deposit and the clean membrane. Those values are related to the surface energy parameters through the Young-Laplace equation by the sessile drop method measurement, which measures the contact angle of the water droplet on the membrane surface in the ambient air [2; 3]. Some important parameters can affect the contact angle values of the membrane, like pH, which affects the charge of both the membrane surface and the liquid macromolecules. These charge effects and adsorption propensity, which depends on membrane properties charge, hydrophobicity and porous structure, can cause different membrane materials to display different fouling propensities [4; 5]. The main objective of our study was to characterize different types of membranes for contact angle measurements, and to understand the effects of membrane materials, molecular weight cut-off and pretreatments techniques on the contact angle values into the details.

2. MATERIALS AND METHODS

2.1. Goniometer

The contact angle values were measured by an OCA 15 Pro goniometer (DataPhysics, Germany) with DataPhysics SCA software controlled system designed for Microsoft Windows. The contact angles of the membranes were measured in sessile drop method. Before the measurement a Hamilton 500 µL syringe had to be filled by the water or solution and fixed a piece of the examined membrane support of 10x40mm dimensions. Then the intensity of the backlight, focus and position of the membrane was arranged. The configurations in the software have to be adjusted, like type of syringe, volume of the droplets, and velocity of dispense.

2.2. Membranes and pretreatments

The new, dry characterized membranes were measured by the above contact angle sessile drop method and then membranes were pretreated by prewetting into distilled water for 24 h at room temperature. Then it was dried with pressurized air and their contact angles were determined again for investigating the influence of prewetting on the hydrophilicity of the membranes.
For characterized the ultrafiltration membranes 4 and 10 kDa molecular weight cut-off (MWCO) polyethersulfone (PES) membranes and a 30 kDa regenerated cellulose membrane; for nanofiltration a thin-film composite (TFC) NE90 (90 Da) membrane and for reverse osmosis a 30 Da LFC thin-film composite membrane were used. The volume of solution or water droplet for the contact angle measurement was increased from 1µL to 20µL for time dependence experiments. All of the measurements were repeated 5 times with each membrane, to calculate an accurate average.

2.3. Contact angle measurements

To measure the time dependence of the contact angle values 10µL of droplet volume was used. The contact angle was measured immediately after the dropping and at intervals of 10 seconds. To measure the effect of fouling on membrane 10µL of droplet volume was also used. A clean and two differently fouled 30 kDa regenerated cellulose membranes were tested and compared. The fouled membranes were produced by the ultrafiltration concentration experiments of model dairy wastewater ($c_{milk\ powder}$=5g/L; $c_{detergent}$=0.5g/L) till volume reduction ratio (VRR) of 5 after ultrasonic pretreatment (at 30 min of retention time a 200 W of ultrasound energy power for treating half liter wastewater was used) and without ultrasonic pretreatment. To analyze the pH effect on contact angle, CL-80 anionic detergent was used to prepare standard distilled water pH solutions from pH 7 to 12.

3. RESULTS AND DISCUSSIONS

In Fig. 1 the contact angles of three kinds of typically fresh, new and dry, commercial polymer membranes (UF: 4 kDa PES; NF: 90 Da TFC; RO: 30 Da TFC), were firstly investigated and compared by contact angle goniometer measurements. The results showed that the increase of droplet volumes from 1 to 20 µL had no significant impact on the results. For a comparison, the values of average contact angle were equal to 64°, 10°, 49° for UF, NF and RO membranes, respectively. The three different types of membrane presented hydrophilic characteristics because the measured values of the contact angles were always below 90°. However the differences between the membrane types were considerable and NF membrane was observed as the most hydrophilic membrane with the lowest contact angle results.

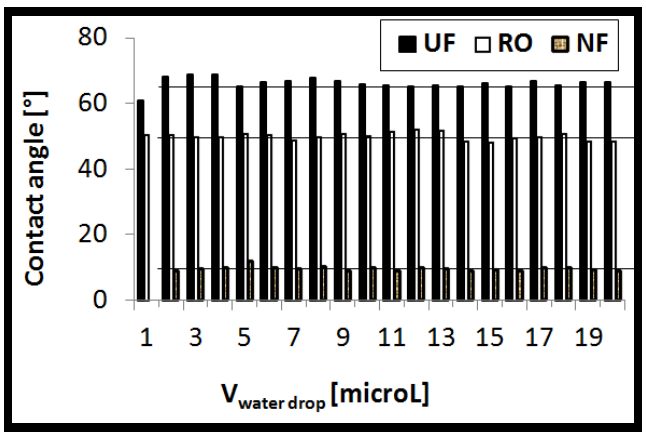

Figure 1. Influence of water droplet volume on contact angles

Fig. 2 presented the effects of pretreatment with water prewetting on the hydrophilicity of the polymer membranes. For a comparison, the prewetting of the membranes increased the hydrophilicity with decreasing of the contact angles by 0.4% 34.4%, 12%, for UF, NF and RO membranes, respectively. It suggests that the prewetting resulted more hydrophilic membrane surface and lower fouling tendency in

each case. The lowest difference was observed using UF membranes, which was not significant, and the highest difference had the NF membrane.

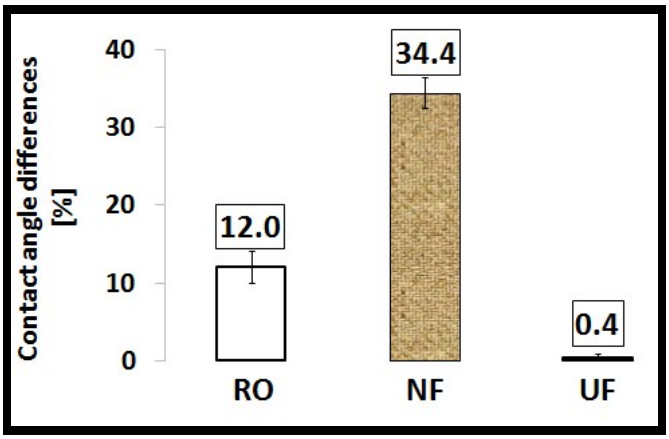

Figure 2. Percentage differences in contact angles between dry and pretreated membranes

The time dependence of contact angles on the surface of higher MWCO membranes can be quite important, since the values could change as a function of wettability. To measure this phenomenon prewetted 4 and 10 kDa PES membranes were analyzed and shown in Fig. 3. The contact angle decreased from 49.2° to 41.2° (which means 16.3 % decreasing rate) and from 43° to 37.7° (12.3 % decreasing rate) testing 4 kDa and 10 kDa UF PES membranes, respectively. In the case of NF and RO membranes the contact angle changing as a function of time was not significant due to the smaller MWCO. However, the UF MWCO is important to change the time dependence of the contact angles, the polymer type of the membrane is also important parameter. From our experiments it was obvious that regenerated cellulose UF membrane did not have effect on the time dependence of the contact angles even if it had higher 30 kDa MWCO compare to the (4 and 10 kDa) PES membranes.

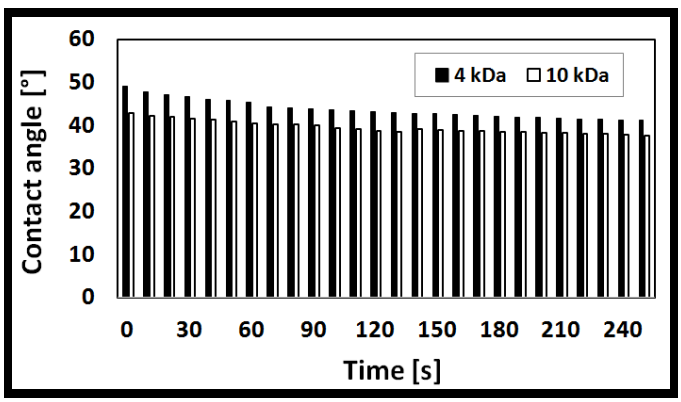

Figure 3. Time dependence of contact angle values on pretreated 4 and 10 kDa polyethersulfone membranes

In Fig. 4 the contact angles of a fresh, clean and dry membrane and two differently fouled 30 kDa MWCO regenerated cellulose membranes are shown. The fouled membranes were analyzed after ultrafiltration concentration experiments of model dairy wastewater with and without ultrasonic pretreatment, with the same parameters as we discussed in Materials and methods. Based on the results it could be concluded that the fresh membrane had the most hydrophilic surface and the fouled membranes had higher contact angles. Moreover, the ultrasonically pretreated wastewater ultrafiltration resulted the highest contact angle (75.9°), which indicates that the ultrasound pretreatment resulted higher membrane fouling, due to the ultrasound molecular degradation effect.

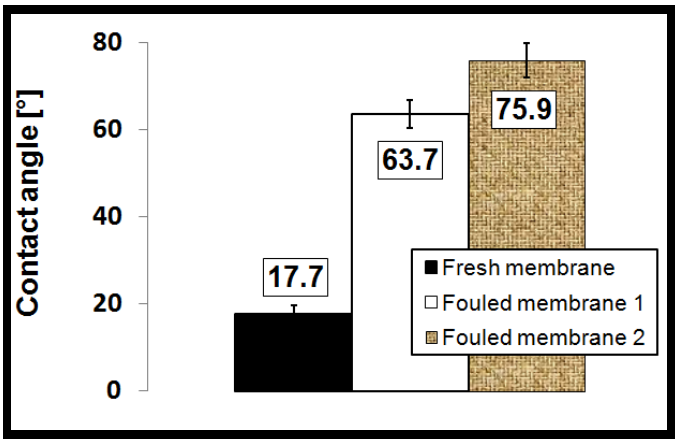

Figure 4. The contact angles of a clean (Fresh membrane) and two differently fouled 30 kDa regenerated cellulose membranes (Fouled membranes were analyzed after ultrafiltration concentration experiments of model dairy wastewater with (2) and without (1) ultrasonic pretreatment)

In Fig. 5 the contact angles as a function of pH are shown. The dry 30 kDa MWCO regenerated cellulose UF membrane in contact with the different detergent pH solutions changed the wettability of the membrane surface. The contact angles decreased from 63.3° to 22.1° as the pH value increased from 7 to 12. From our results we can conclude that the alkaline pH resulted higher membrane hydrophilicity, since the surface features were changed significantly.

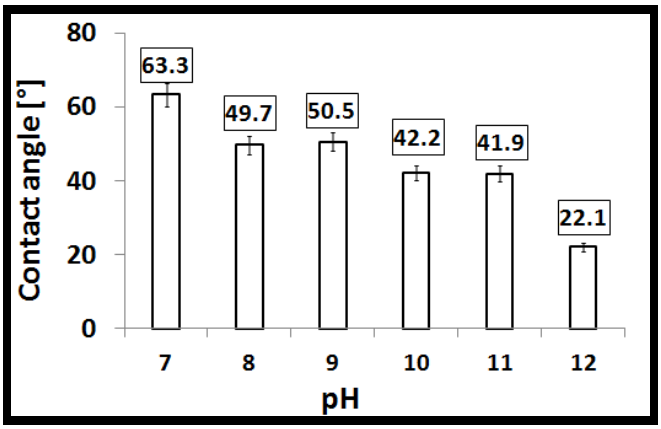

Figure 5. Contact angle values versus pH increasing

4. CONCLUSION

From the water droplet volume changing experiments we can conclude that the increase of droplet volumes had no significant impact on the contact angle values. Compare to the results of UF, NF and RO membranes the differences between them were considerable and NF membrane was observed as the most hydrophilic membrane. The membrane pretreatment experiments with water prewetting showed us that the pretreatment resulted more hydrophilic membrane surface and lower fouling tendency in each case. The lowest contact angle difference was observed with UF membranes, as well as NF membranes showed the highest difference. Our time dependence of contact angle experiments suggested that the UF MWCO was important to change the time dependence of the measuring, but the polymer type of the membrane was also an important parameter. It was obvious that the regenerated cellulose UF membrane did not have effect on the time dependence of the contact angles even if it had higher 30 kDa MWCO compare to the 4 and 10 kDa PES membranes. Based on the results of the fouled membranes experiments it can be concluded that the fresh membrane had the most hydrophilic surface and the fouled membranes had higher contact angles. Moreover, the ultrasonically pretreated wastewater ultrafiltration resulted the highest contact angle, which indicated that the ultrasound pretreatment resulted higher membrane fouling, due to the ultrasound

molecular degradation effect. Finally, the pH experiments proved that the alkaline pH resulted higher membrane hydrophilicity, due to the significantly changed membrane surface features.

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ENZIME RECOVERY BY ULTRAFILTRATION FROM BROTH

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ABSTRACT

Recycling waste products of food industry is important: one side because of the environmental aspects and the other side because of the economic reasons. The one of the most preferred basic material for second generation bio-fuels might be the tobacco (Ábel et al. 2011). The cost of the process depends on the cost of the hydrolysis of cellulose/lignocelluloses i.e. and the cost of the enzymes. These enzymes are very expensive and that is why it is so important to find a good enzyme recovery method.
In my research the membrane separation was used for enzyme recovery. Different polyether-sulphone membranes with cut-off value of 7 kDa (PES7) and 10 kDa (PES10) were used for separation the hydrolyzate.

Keywords: recycling, enzymes, membrane

1. INTRODUCTION

Tobacco plants *(Nicotiana tabacum)* produce abundant biomass and could be used to produce abundant biofuels. Tobacco grows to heights between 1 to 2 meters and it is sensitive to temperature, air, ground humidity and type of land. Temperatures of 20-30 °C are best for adequate growth, an atmospheric humidity of 80 to 85%. Tobacco produces high-value products and an enormous amount of biomass, which can be converted into food products or industrial raw materials and naturally produces large volumes of starches and sugars. Tobacco represents an attractive and promising energy plant platform and could serve as a model for the utilization of other high-biomass plants for biofuel production.

Enzyme recovery and recycling is one of the most important and effective way of increasing the efficiency of the enzymatic hydrolysis process by lowering the enzyme costs.

A considerable number of enzyme recovery/separation methods are known, but the low energy consumption, good separation efficiency and high quality of the final product are the main attractions of membrane separation processes in bio-refining and bioenergy production [de Morais et al. 2009; Szélpál et al., 2013]. Among the specific membrane processes for biorefining ultrafiltration (UF) appears to be particularly suitable for enzyme separation. Its molecular weight cut-off (MWCO) value might be the same as the applied enzyme –complex average molar weight. In the biological industries, fouling results a significant decline of the permeate flux in course of UF. Many techniques are applied to overcome fouling, such as vibration [Hodúr et al., 2009;], gas sparging [Cui et al., 2003], back-flushing [Srijaroonrat et al., 1999] and pulsatile flow [Finngan et al., 1989] but the knowledge available on membrane cleaning still seems insufficient for practical membrane filtration systems [Hilal et al., 2005].

2. MATERIAL AND METHODS

Raw material: “Experimental” and “By-products” tobacco samples were get from a Hungarian tobacco plant cultivation. The “experimental” (EX) samples were the whole plant, the stem and leaves at all. Meanwhile the “by-product” (BY) consisted mainly on the stem, the part of plant after tobacco-processing. The samples were cut and frozen after harvesting immediately and were keeping in deep frozen until hydrolysis. One part of the samples was cut by cutter to reduce the size of particles before hydrolysis.

Enzymatic saccharification: The hydrolyzate was made from experimental (EX) and by-product (BY) tobacco samples. It was prepared in a 2L fermentation unit (Labfors Minifors, Belgium) at 30°C±0.2 and pH 4.5±0.1. The enzyme was endo-1,4-β xylanase (Sigma Aldrich) from *Trichoderma longibrachiatum* and the dose was 2000 mg/L

Modell solution: 200g of sugar, 1L of water and 4g enzyme endo-1,4-β xylanase (Sigma Aldrich) from *Trichoderma longibrachiatum*

Ultrafiltration: Separation was carried out stirred cell devices with capacity of 400 cm^3 or 100 cm^3, equipped with a 0.004534 m^2 or a 0.001734 m^2 polyether-sulphone (PES) membrane with an MWCO of 7 and 10 kDa. The sample was mixed continuously with a magnetic stirrer during separation.

The selectivity of a membrane for a given solute and the efficiency of the process were expressed by the retention (R):

$$R = \left(1 - \frac{c}{c_0}\right) \cdot 100 \quad (\%) \tag{1}$$

Where c is the concentration of the permeate phase (% or mg dm^{-3}), and the c_0 is the concentration of the feed (% or mg dm^{-3}).
The permeate flux (J) can be described as a function of time:

$$J = J_0 t^{-K} \quad (Lm^{-2}h^{-1}) \tag{2}$$

J_0 is the initial permeate flux (L m^{-2} h^{-1}), t is the filtration time [h], and K is the fouling index.
The membrane resistance (R_M) was calculated as:

$$R_M = \frac{\Delta p}{J_w \cdot \eta} \quad (m^{-1}) \tag{3}$$

Where J_W is the flux of water (m^3 m^{-2} h^{-1}) through the clean membrane, and η is the water viscosity (Pas). The fouling resistance (R_f) of the membrane can be measured by washing the gel layer from the membrane. R_f and the resistance of the gel layer (R_g) can be calculated as:

$$R_f = \frac{\Delta p}{J_{WW} \cdot \eta} - R_M \quad (m^{-1}) \tag{4}$$

$$R_g = R_T - (R_M + R_f) \quad (m^{-1}) \tag{5}$$

Where J_{WW} is the flux of water (m^3 m^{-2} h^{-1}) through the fouled/washed membrane.
Reynolds' number in the case of mixing can be calculated via the equation (6):

$$Re_{mix} = \frac{d^2 n \rho}{\eta} \quad (-) \tag{6}$$

Where ρ is the retentate density (kg m^{-3}), n is the rotation rate of the stirrer (s^{-1}), η is the viscosity of the retentate (Pas), and d is the diameter of the stirrer (m).

Protein content: The protein quantity was determined by the Kjeldhal method (KJELTEC 2300 FOSS, Based on Tecator Technology). The method is applicable to the determination of nitrogen occurring in the trinegative state in food and raw materials.

The method consists of three steps: 1) Digestion of the sample in sulphuric acid with a catalyst. The nitrogen contained in the sample is converted to ammonia; ammonium sulphate being formed. 2) Distillation of ammonia released from ammonium sulphate by addition of an excess of sodium hydroxide; ammonia being trapped in a trapping solution (sulphuric acid). 3) Back titration of the excess of the trapping solution. The percentage of nitrogen found in the original sample can now be calculated by:

$$CP = \%N * 6.25 \tag{7}$$

It is also possible to calculate the amount of crude protein in the sample. Although there are differences between different samples, the amount of crude protein (CP) can be found by multiplying the percent Nitrogen by a factor (usually 6.25).

3. RESULTS AND DISCUSSION

The flux vs. time data are shown in Fig. 1. There is a big difference between the separations with 7 kDa and 10 kDa membranes due to their cut-off values.

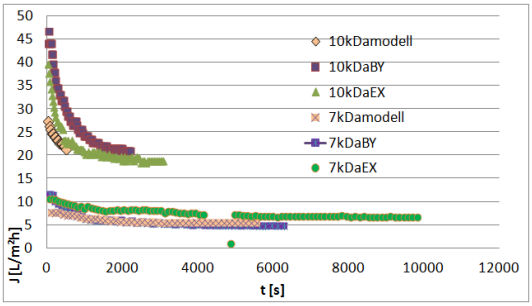

Figure 1. Flux values of the model, EX and BY tobacco samples with 7 kDa and 10kDa PES membrane

The differences between the samples are not so sophisticated, even between the model solution and the samples also. It is show that the component of the model solution was selected in a right way, the most important components are added to the model solution.

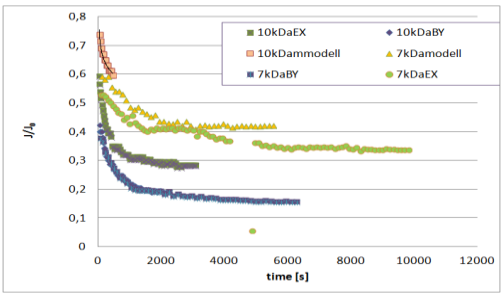

Figure 2. Relative flux values of the model, EX and BY tobacco samples with 7 kDa and 10kDa PES membrane

The relative flux values (Fig. 2.) shows better view of the separation. The relative flux values give us an information about the decreasing tendency/velocity if the flux value. These data shows the steepest decline is at the BY samples, the lowest rate of decline at the models. What means that the BY samples consist of the most smallest components which can foul the pores inside of the membrane or can make less porous structure to the gel layer.

These phenomenon is confirmed by the fouling indexes as well (Fig. 3). the fouling indexes are calculated by (2).

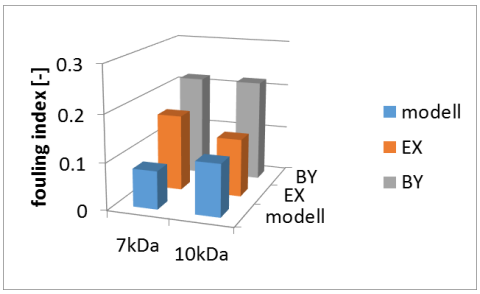

Figure 3. Fouling index values of the model, EX and BY tobacco samples with 7 kDa and 10kDa PES membrane

Three different membrane resistance values were measured during the experiments, first the membrane resistance (Rm), second the fouling resistance (Rf) and finally the resistance of the gel layer on the surface of the membrane (Rg) (Fig. 4).

In this measurements the 7 kDa cut-off value membrane has a higher resistance values and the BY samples give the highest among them.

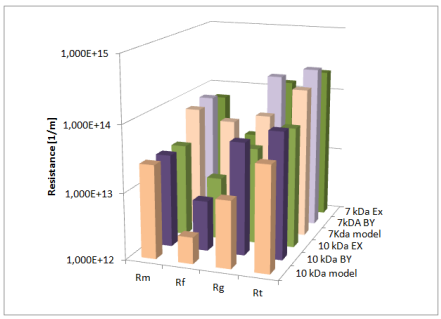

Figure 4. Resistance values of the model, EX and BY tobacco samples with 7 kDa and 10 kDa PES membrane

The protein retention was measured as an indicator of enzyme recovery. The retention values show (Fig. 5) that the enzymes could be separated into the concentrate phase. The best separation is shown by the model solution, since it has only the enzyme as and N-content component, i.e. the permeate has hardly any protein content. Meanwhile the BY and EX samples has other protein and protein-type components, so the ratio between the protein content (N – content) of the permeate and the feed originated not only from the enzymes. The retention is better at the smallest cut-off values, and better of the BY samples at any case.

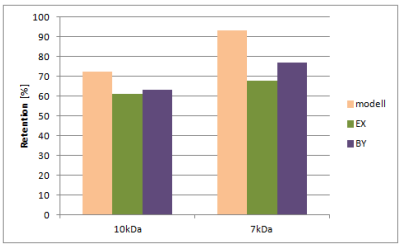

Figure 5. Retention values of the EX and BY tobacco samples with 7 kDa and 10 kDa PES membrane

4. SUMMARY

The cellulose content waste recycling for bioethanol production might be successful even economically as well if the key elements of the technology are well designed. One of the key elements is the enzymatic saccharification. When the enzyme would be reusable, the price of the unit operation is less.

Two different by-product samples and model solutions were used as examples. The samples came from the tobacco industry – BY samples, and from the tobacco cultivation – EX samples. The fermented samples were separated by 7 kDa and 10 kDa membranes for recovering the enzymes. Our data show the ultrafiltration itself is a possible method for enzyme retention, but the cut-off values might be too big for achieving a real cost related enzyme retention.

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EXPERIMENTAL APPLICATIONS OF ARTIFICIAL NEURAL NETWORKS IN ENGINEERING PROCESSING SYSTEM

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ABSTRACT

Artificial Neural Networks along with Image Processing Systems have proven to be successful, particularly in the domains of mathematics, science and technology. They have gained quite notable advantages beyond classical learning, as their usable engagement are observable in many fields of scientific environment related to the relevant systems. This paper presents a model for identifying the small components parts. The model may b**e** significant in various industries mainly in engineering processing system areas. The objective of the study is to apply Artificial Neural Networks (ANN) in Image Processing System (IPS) with feed forward structure to detect, and recognize different parts or any other environment products on a moving conveyor bel. In the proposed model, we have used appropriate method of edge detection. The edge detection realizes artificial neural network with noise. The paper emphasizes the implementation of the model considering functionality, parts images, accurate detection and identifying the different components. The result shows that the model can detect moving objects (products of many kinds) accurately on the conveyor belt with very high success rate and sort them accordingly for further processes.

Keywords: process engineering, model, ANN, detection, products.

1. INTRODUCTION

Recognition is the classical problem in image processing, and machine vision. It is related to the determination of the image, which contains some specific objects, features, or activities. This operation can normally be solved robustly and without effort of a human, but is still not satisfactorily solved in machine vision for the general case, involving arbitrary objects in arbitrary situations. The existing methods for dealing with this task can solve it only for specific objects, such as simple geometric objects, human faces, printed or hand written characters. Furthermore in specific situations, typically described in terms of well-defined illumination, background, and pose of the object relative to the camera, [1, 2] and [6, 8]. Artificial Neural Network (ANN), as a problem-solving tool, which imitates the process of human brain reactions has become an alternative method to recognize an image through training, [7]. MATLAB is the abbreviation of matrix laboratory, which has several hundred built-in functions packages and thirty kinds of tool kits. Many design, training and simulation functions of the Neural Network (NN) are provided in a NN toolbox. In this paper, we have used the MATLAB ANN Toolbox with Levenberg-Marquardt (LM) algorithm; and Feed Forward architecture. In ANN training process, the LM training function has less iteration than traditional Back Propagation (BP) and other improved algorithms while the convergence rate is faster and the precision is higher, [3, 4]. In feature extraction process, we extract five features for each object, [6, 7] and [10] to recognize objects. Proposed method uses lower inputs to ANN and tends to higher efficiency of vision system. This method is suitable for real time recognition systems compared with previous research; because we can get better iteration time, speed of belt conveyor and accuracy. At this paper, we have also examined our search only on a small belt conveyor in order to see how fast the image processing happens with the proposed application of model, because our further work may be on material handling of the small parts using the same procedure.

2. METHODOLOGY, HARDWARE AND SOFTWARE

We have used a web-cam HD-6000 to capture the objects in conveyor belt. The captured image is processed by a program developed in C#. NET environment. Feed forward neural network algorithms implemented by MATLAB functions, sending the output signals to the microcontroller ATMMEGA8. This microcontroller, which is connected to a personal computer via Universal Serial Bus, orders a servo motor's angle of operation to differentiate the small components in separate places. As regards the software development framework, the first level in the machine vision is the image processing algorithm, [4, 8]. It would analyze and extract useful information from the image. The model of software structure is shown in Fig. 1.

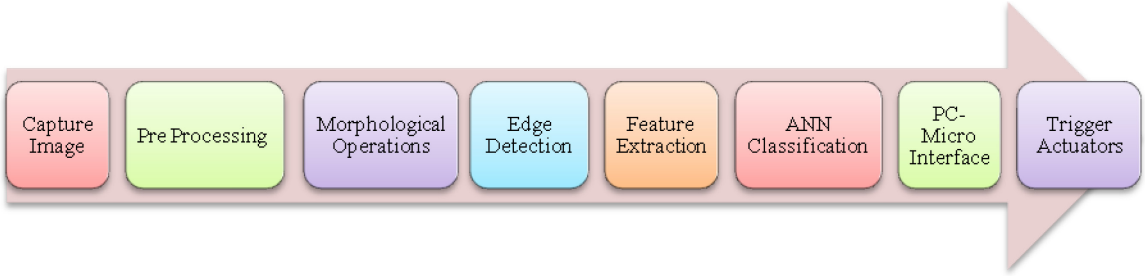

Figure 1. Software framework development structure

2.1. Second-Level Heading

Images captured by web-cam are in the RGB (Red, Green, and Blue) format, and because we do not need color information, the image is converted into grayscale color map. Using the adaptive threshold algorithm, the image is changed into binary form, which is suitable for further recognizing process, [2, 4] and [8].

2.2. Image Pre-Processing

The aim of the pre-processing is to make the blurred images become clear. Median filtering method can preserve edges and makes the noise out away, thus the image can be recovered well, [5, 9]. Median filtering, which can effectively suppress noise, is a nonlinear signal processing technology based on the sorting statistical theory. The method replaces the value of a pixel by the median of the gray levels in the neighborhood of that pixel. We usually use image sharpening treatment based on Laplace method in time domain. After pre-processing, the quality of image is improved significantly.

2.3. Morphological Operations

After pre-processing phase, in order to connect interrupted lines, we apply mathematical morphology dilation command. After this process, we clear the holes in image and eliminate noise coming from the outside line of the conveyor belt, [5, 9].

2.3.1. Edge Detection and Feature Extraction

Image which is processed by the first order differential equation usually produce relatively wide edge, so we use the gradient method based on the first derivative to enhance the edge of image. The approximate gradient of the image f(x, y) is:

$$\nabla^{\uparrow}2\ f(x,y) \approx |G_{\downarrow}x| + |G_{\downarrow}y| = |\partial f/\partial x| + |\partial f/\partial y| \quad (1)$$

The above equation can be described by 3 × 3 filter mask shown in Fig. 2, and the approximate result is:

$$\nabla f(x,y) \approx \{|(a_7 + 2a_8 + a_9) - (a_1 + 2a_2 + a_3)| + |(a_3 + 2a_6 + a_9) - (a_1 + 2a_4 + a_7)|\} \quad (2)$$

In the above equation, we can find that the difference between the third row and first row is close to the differential in the x-direction, and the difference between the third column and first row is close to the differential in the y-direction, this can be expressed by 3 × 3 mask matrix illustrated in Fig. 3, where mask is called Sobel operator, [6-7]. After treatment by Sobel operator mask, the edge of image will be significantly more intuitive and the processed image is conducive to feature extraction.

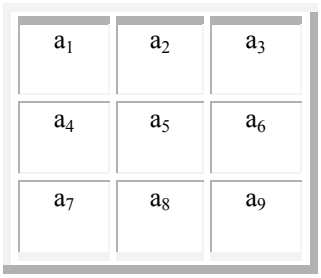

Figure 2. Filter mask structure [3 × 3]

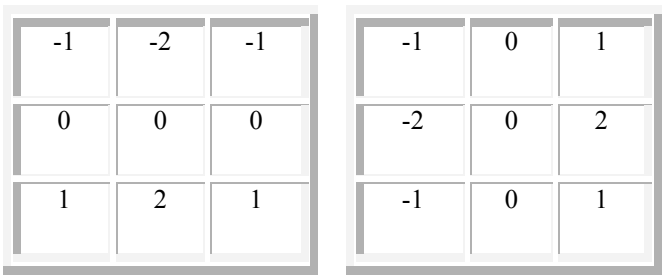

Figure 3. Sobel operator filter mask (left for vertical and right for horizontal edge detection)

Edge detection is done by using the Sobel operator to show the second shape of the object, [6-7]. After that we can extract two other features from object. If we calculate count of white pixels in image, we can define second feature as "PERIMETER", also by dividing "area" to "perimeter" we obtain third feature for objects. Then we define two other parameters as "length" and "width" by using length and width of detected object.

2.3.2. Neural Network Architecture

ANN has a multi- layers perceptron structure, which uses feed forward back propagation neural network. This structure has one input layer, one or more hidden layers and one output layer. The information enters to input layer and after manipulation is sent to output layers**,** [9, 3]. The back-propagation algorithm uses the gradient of the performance function to determine how to adjust the weights to minimize errors that affect performance. In this paper, the activation function of each node uses a sigmoid function, $f(x) = 1/(1+ e–x)$. Sigmoid function generates values between (0, 1), so values are normalized before input the network and reduced between (0, 1). Feed forward training and application is shown in Fig. 4. We define an input vector of size 1*5 for neural network features generated in image processing phase. We tested some structures for our network by some parameters shown in Tab. 1. According to this table the obtained result achieved in method No. 9, by Mean Squared Error MSE = 2.0785e-12. Fig. 5 shows the training results obtained from Tab**.** 1.

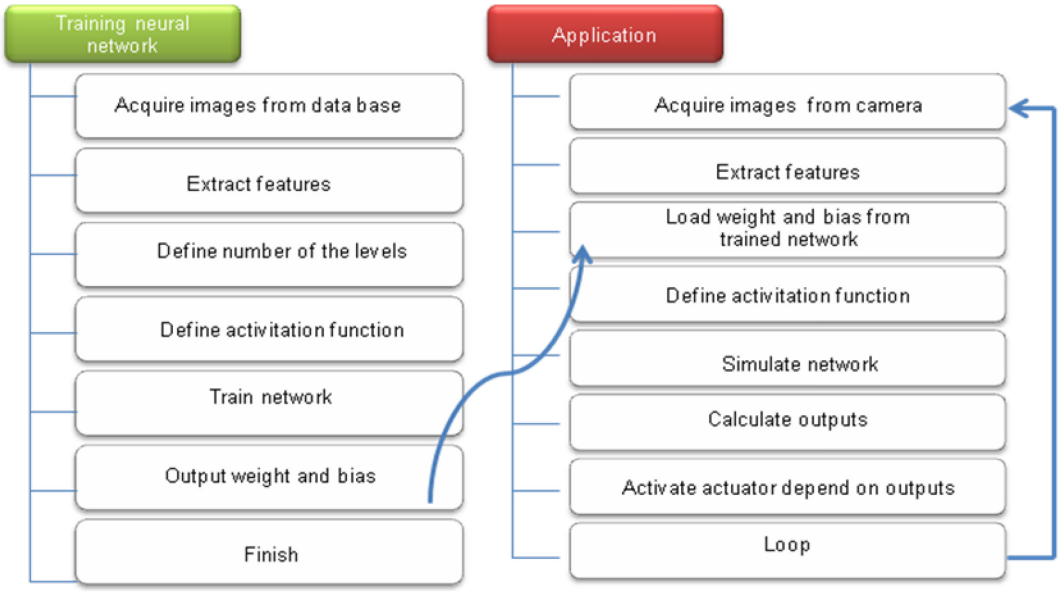

Figure 4.Training and application flowchart of Neural Network

Table 1. The heuristic results for different hidden layers and activation functions

Method	Hidden Layers	Neurons	Activation Functions	Iteration	MSE
1	1	5-3	tansig- purelin	10	0.01118
2	1	10-3	tansig- purelin	15	0.01089
3	1	15-3	tansig- purelin	23	0.00378
4	1	20-3	tansig- purelin	16	0.01932
5	1	25-3	tansig- purelin	10	2.034e-5
6	1	30-3	tansig- purelin	14	0.01009
7	2	15-5-3	tansig-tansig-purelin	20	3.79e-12
8	2	10-5-3	tansig-tansig-purelin	14	0.00774
9*	***2***	***5-5-3***	***tansig-tansig-purelin***	***18***	***2.0785e-12***
10	2	5-3-3	tansig-tansig-purelin	21	1.765e-7
11	2	10-3-3	tansig-tansig-purelin	50	3.295e-7
12	2	15-3-3	tansig-tansig-purelin	15	2.977e-7
13	1	15-3	logsig-tansig	13	7.73e-12
14	1	15-3	logsig-logsig	18	0.00076
15	1	15-3	purelin - logsig	27	2.18e-10

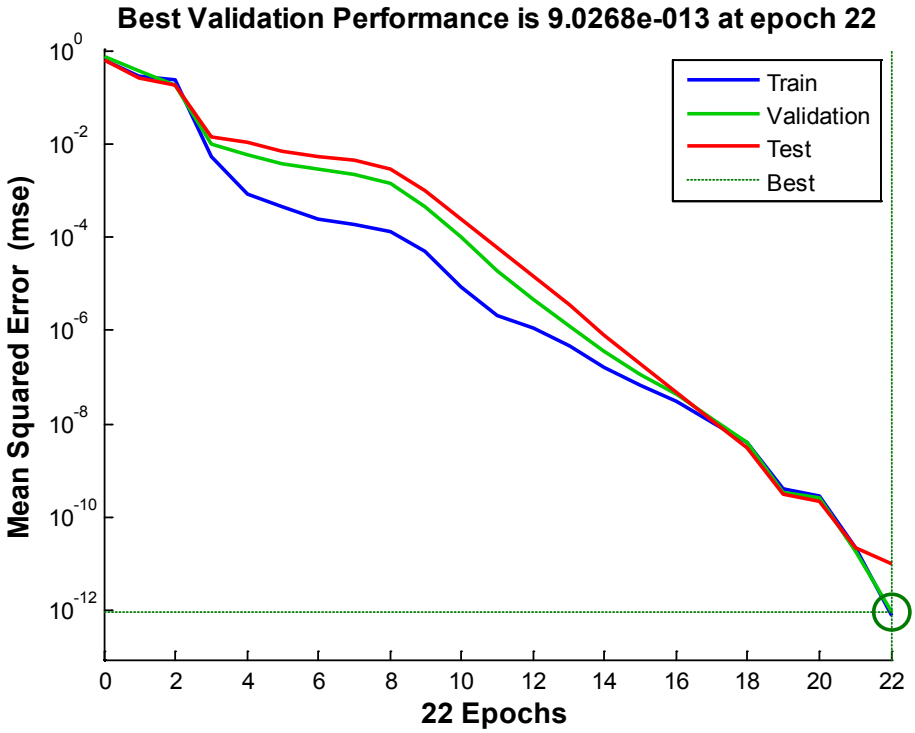

Figure 5. Output results of neural network training

3. RESULT AND EVALUATION

Several researchers have used image-processing techniques for object recognition. A series of morphological operations were implemented to produce only an image of nutmeat from an image containing a number of nuts. Color segmentation to locate and remove the long stems attached to mechanically harvested oranges. Their color segmentation algorithm had 100% success in discriminating the stemmed oranges. However, the algorithm misclassified some pixels of the stem-calyx as background. Some scientists used color machine vision for the detection of weeds in wheat and soybean fields. They used a color index for both the preprocessing and statistical analysis for weed detection. Their experiments worked well with statistical analysis compared to the two neural networks they trained. Rapid identification of objects with different features, materials and weight and color may be another important use of artificial intelligence and image processing system in recycling processing systems. This experimental work at this study shows satisfactory results as compared to the standard Artificial Neural Network technique while maintaining same threshold error and a good processing speed-up in terms of success rate, speed of conveyor belt, and types of machine tools. The success rate is quite good at 10 cm/second for fixed speed of conveyor belt. This success rate with reference to literature used at this study, it is not a very bad result. But from author's point of view, a very satisfactory achievement might be performed in a place where there are no much fluorescent lighting, which of course increase the result ratio. The accepted and suitable results may obtain in an actual work place with its own conditions. In other word the correct and reasonable experimental test must be performed in an arbitrary place with arbitrary products of any kind. Then this paper might be evaluated to achieve the mentioned arbitrary materials with different colors, size, shape and features.

4. CONCLUSION

This paper focuses on the recognition system of small component parts like (machine tools) on a moving belt conveyor in real time. Mathematical analysis shows that edge detection is realized using artificial neural network (ANN) with noise. Supervised learning method with momentum is used. Laplacian edge detector is a teacher of artificial neural network. In this study, it is shown that Laplacian edge method can be used for training of ANN as edge detector. Testing is done using a real-time visual recognition system.

The MATLAB software is used to integrate all algorithms (developed from image processing algorithms and ANN supervised learning method). Concerning the edge detection, some tools were used as extracted features.

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HOW CAN WE SPREAD THE QUALITY VIRUS IN DOMESTIC ORGANIZATIONS?

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ABSTRACT

There is no room for debate about that the quality is one of the most important competitive factor and nobody against that this quality virus has to be spread. The paper would like to help with methods and techniques -what are not well known and used in the domestic organizations- to spread this virus in different fields of the organization. Its strategic motto is: Instead of quality management development and improvement the quality of the management has to be developed in the interest of quality management.
Today, that idea has to be given up what says more and more modern quality systems development start is needed instead of it the whole quality of the management has to be developed. High level of the quality system is not equal with the high quality of the management. It has to be turned. The high level of the management quality will ensure the possibility of well operating high level quality management. The paper wants to present this from different aspects on the one hand by comparing the classical development of quality management systems on the other hand by new (volume, profit and quality) approaches of certain management elements and methods.

Keywords: quality virus, quality conscious management, Seghezzi palace, management and quality management connections, new audit approaches, domestic quality model.

1. PERIODS OF THE QUALITY VIRUS FROM QUALITY CONTROLL TILL INTEGRATED MANAGEMENT SYSTEMS

1.1. First period: QC

Main characteristic of the first step is the quality check (QC). The small quality virus (black point on the Fig. 1) started to infect the quantity and profit oriented production systems with the philosophy of quality. The first phase was characterized by strong finished product control. The paradox from management point of view is that the Quality Department is responsible for the quality but they have no active effect on production. They are responsible for the finished products and the incoming parts control. This kind of checking system has only very low passive effect on the real quality of the product. Only separation of the bad and good quality raw materials, incoming parts and final products. This is not so much but a good starting point.

1.2. Second period: PQC

In the second phase, the focus moved to strong production quality control (PQC).The focus is on the production process but this is not a quality step ahead just the small quality virus started to grow (blue circle on the Fig. 1) and infects the production area not just the in and out coming process are infected like at QC. From management point of view, this step means that the production will be responsible for the quality of its tasks. This is the start point where everybody starts to be responsible for the quality of his tasks (not only for quantity, deadline, costs etc.). This is the start of privatization of quality.

1.3. Third period: TQC

In the third period the virus started to grow quickly. This period is the total quality control. The first seriously infected companies were in Japan and USA with two difference mutations. In Japan it was called TQC (Total quality control), in American it was QA (Quality Assurance), later came Europe with QSS (Qualitäts Sicherung System) and ISO 9000. These viruses covered the total company and finally the total quality surface. The quality surface got a small thickness (see thick quality surface on the Fig. 1) it turn into a slim (red, yellow, green on the Fig. 1) quality plate (TQM?) and this is the first time when the “T” (total) appears and this is the first time when new symptoms appears what have never seen before these are the audits and these are infected the products. The main focus moved on the product audits. Slowly the product audits changed to process audits because the process audits have bigger effects on the quality than the product audits and the process audits also includes the product audits as well. From management point

of view, the privatization of quality is increasing. Not "only" Quality and Production departments are responsible for quality. Every departments are responsible for the quality like Logistics, Human Resource, Purchasing, Maintenance, Research and Development as well.

1.4. Fourth period: TQM

The real change is the TQM when effective quality virus infected quality conscious management fulfils the entire space around the quality surfaces. Quality plate of the third phase (TQC) started to grow, it became a cube, and this TQM cube is fulfilled with quality conscious management.
It means the TQM cube does not has to be fulfilled with quality it has to be fulfilled with management!
This is the key point, when instead of managing the quality system the comprehensive total management environment (the full cube, the 3 dimensions) takes over the quality consciousness. It gives us the final answer for Kano's dilemma [2]: "Management of quality or quality of management?" The quality of management takes over the leading role from the quality management on the quality developmental way. This is the reason why the process audits are changed to a total complex system audits (finance, human resource, production, quality, etc.). TQM is the most serious period. In this stage all the members of the company are infected very often those companies which are connected with the infected company became also quality virus carriers. The management became total quality conscious management and this is the key point, when instead of managing the quality system the comprehensive total management environment takes over the quality consciousness.

If the TQM is symbolized with a cube, in that case in the TQM cube arrows show, the two dimensional changes (planar, spatial).

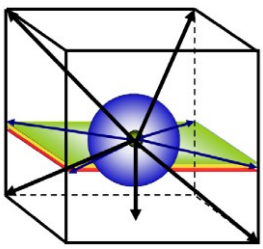

Figure 1. How the small quality virus infect the total organization [5]

The infected management areas are the follow:

Table 1. 12 elements of TQM [3]

12 elements of TQM:	
Strategy management	Projekt and teamwork management
Quality and reliability management	Accounting & Finance management
Human Resource management	IT management
Design management	Management of quantitave methods
Marketing management	Production and technology management
General management culture, decision system, leadership theory	Issue based problem solving

That accepted approach what say we have main and support process stronger and weaker departments has to be leaved. The SWOT analysis and the linked Pareto based development programs delivers low results - from the whole company point of view- because the not A-category fields, departments will be never be developed. They remains weak. Better is to have a lower management levels across the organization than one extremely strong.
Therefore it is important the right distribution of resources among the different management fields. Focus cannot be only on the main productive systems, marketing and the other 11 elements (see Tab. 1.) have to

be on the focus as well. Just on example: we could produce super high quality products with extremely low cost if nobody knows our product because the marketing budget is so low…
The decision of how to distribute the resources always has to be done in the given situation, in the given organization to get the most effective way to grow the organization. But for the right decision the managers has to know each other fields very well. For this skill they need interdisciplinary universal management knowledge. The entire system is no stronger than its weakest link!

But what quality virus infected companies are doing after the fourth TQM period? Why the quality management is still improving? Does fifth or even sixth period existing?

1.5. Fifth period: New driving forces.

In 2006, Feigenbaum explained the last 10-15 years tendencies on an international conference. The TQM is still improving and it is caused by six long evolution driving forces what are the follows:

- New effective approaches, methods and practices (QC, SPC, TQM, method systems) appears,
- Leading companies use these good practices, benchmarks are exists,
- Quality competition is globalized (and quickly change!),
- Customer satisfaction/dissatisfaction spread extremely quickly due to new possibility of information technologies,
- Organizations are continuously looking for new possibilities to increase the customer satisfaction (PDCA, CQI, CIP),
- Lead organizations keep the quality in the focus of their strategy.

1.6. Sixth period: IMS

Latest period could be the follows according to J. Topár [10]:

- The quality of management determines the success of the quality conscious company. But for this the quality management and its targets have to be integrated into the total organization so TQM conceptualization and practice focused management is needed.
- Integrated management systems (IMS) are needed where the essential management elements (sub systems – quality, health, security, environment, information, security systems, supplier, social responsibility etc.) of the company/organization/system have to be operated in one common integrated system.
- To increase the quality of management requires a comprehensive culture change in the company what reach all the level of management and every employee.
- Key factor of the operation is the continuous development. To measuring this the EFQM model [11] could be used what helps with a regular self-evaluation to systematically identify the strength and weakness of the organization and treat these points.
- Role of the third party certifications dynamically changed.
- Supplier, partner networks rethink is needed. Improvement and development processes have to be harmonized. Real information has to be shared.
- Sector specific quality systems and methods are used in service systems like public services: health care, administration, public education, public transport.
- The specific culture of the given organization have to be taken into consideration more significantly during the quality system and method selection process.
- Methods integrated into method systems (e.g. PDCA, DIMAIC, Six Sigma, Lean).
- Method systems converge to quality models and quality systems.

All in all the key points where methods and approaches have to be changed:

- Management areas connection,
- Management areas connection to quality management,
- Quality management connections with further quality functions,
- TQM and management and the quality management connections,
- Business excellence and well-operated quality system connections.
- Quality conscious managers, employees and owners are needed.

2. DEVELOMENT OF MANAGEMENT SYSTEMS AND THEIR CONNECTION TO QUALITY MANAGEMENT

With a view of above trends, it was analysed from management science development point of view how the quality was integrated into the management systems and organization targets. This development presented on the follow "management by…" figure:

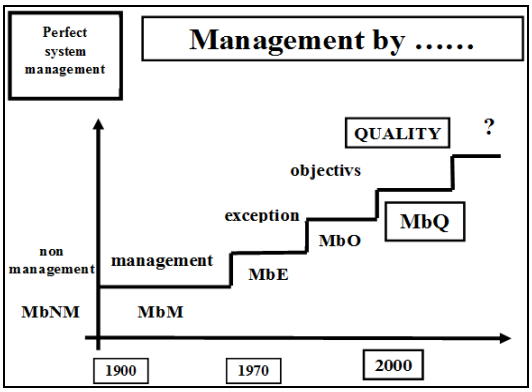

Figure 2. Management systems development till MbQ (=TQM?) [5]

To follow these periods, steps the organization could reach the TQM = MbQ management level. The whole company could be infected if the organization put the quality into the main focus of the management so a quality committed management culture has to be implemented and operated. From this point of view in the main focus of the development has to be the management. It has to be developed to a quality conscious management. Among the organization targets have to be the quality (e.g. instead of current management by objectives or management by exception or just volume or profit oriented management).
So all in all the quality of the management has to be developed. In line with quality of management development process those management methods have to be used what could support the quality-focused targets (quality conscious culture spread could be led by strategy human resource and quality management). This methods could be the follows:

Table 2. Classical QM and new TQM methods [3]

Classical QM methods, what partly used by TQM	Comprehensive new TQM methods
– Error analyze methods: ▪ Pareto/ABC, ▪ Ishikawa, ▪ FMEA/FMECA, ▪ TIPHIB, – Problem solving methods, – QFD/QH (quality house), – Quality teams, – List of open points, check lists, – Quality audits, – Statistical methods, – Flowcharts, – Statistical process control cards, – 5W + 1H, – 5S, – 7 steps problem solving, – 5M, – Sampling methods.	– Data collection, visualization, analyze, – Benchmarking, – SWOT analyze, – Environment and market analyze, – Portfolio analyze, – Organization analyze, – Mission, vision, – Management style, – Company culture and development, – Communication analyze, – Motivation analyze, – Conflict and risk management, – Environment protection and culture, – Company audit, – Human resource analyze and development, – Work safety, health, work culture, – JIT; TPM systems, – PQC, SQM, – 7M, 9M, – PDCA problem solving, – Method systems (PDCA, six-sigma, lean), – QM method extension to non QM areas, – Decision making process and delegation analyze.

The effectiveness of the usage of certain methods significantly increases if these quality system methods are fitted to the organization specialties.
For example, it can be observed that each error analysis methods have been frequently used in combination, depends on their advantages and disadvantages. It is obvious for an Asian model using organization where lot of teams working continuously with lot of team members since several decades with significant quantities of good "quality" data and with strong IT background ([9] minimum of "how much?" but often "why?" type of data) the follow error analysis order would be good: 1. ABC Pareto analysis 2. For 'A' errors ISHIKAWA analysis, 3. for each of fishbone FMEA 4. for the most risky issues, a PDCA quality improvement projects with a narrower homogeneous team.
But for example, in the domestic practice where few teams working only with few team members and often the documentation is completely missing or the data and the IT support is on “when?” level [9] the follow error analysis order would be good for them: 1. brainstorm or TIPHIB (typical sources of error) analysis with large heterogeneous team 2. for the typical or highest risk errors ISHIKAWA or a Pareto data record 3. fix these critical issues with PDCA projects. My opinion is, in the domestic practice purpose to begin the analysis with more general methods (e.g.: strength-weakness analysis, SWOT, TIPHIB) or other soft, heuristic methods (e.g.: brainstorm addition to the foregoing, Kawakita, Jiro, 5W + 1/2 H methods, 6.5 S, PDCA).

3. BUSINESS EXCELLENCE AND WELL-OPERATED QUALITY SYSTEM CONNECTION TO CULTURE

3.1. Seghezzi palace and American island

The American island approach completely goes against the above written TQM and quality conscious management approaches, and it is accepted in the domestic practice as well, which does not place the focus on the development of the total management system, but out that where the whole organization is less sensitive to quality, higher success could be achieved, if an appropriate quality island, a department, expanding on the total company. - but the precondition of this is the quality of culture of society.
According to Seghezzi - European guru of quality management – the fundamentals of the quality palaces are the quality of the culture of the society. Only after a quality turn in the culture is realistic to reach success with a quality model in the practice especially if it is TQM based model.

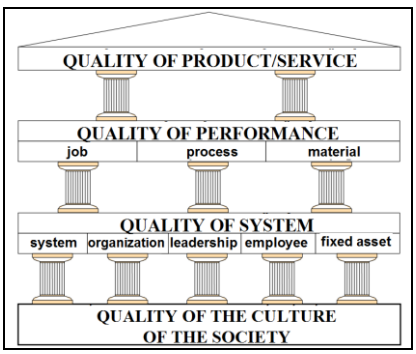

Figure 3. Seghezzi quality palace model [6]

Recent quality palaces are usually turned with 180°. The basic is the strict activities of the quality control what is focusing on the quality of the product/service. We can say that the basic of a comprehensive quality conscious development of the quality of management could be a turned pyramid, a turned palace. In the interest of a fully comprehensive quality turn of the management, the quality system itself has to be turned!
According to my understanding, the comprehensive definition among the quality definitions is the quality management what includes all the quality activities. The hierarchic pyramid of these activities are the follow:

- Quality management,
- Total quality control,
- Quality assurance,
- Quality control.

All in all according Seghezzi the companies have to support the development of the quality of culture of society to help to build up a stable quality palace.

3.2. Instead of better management of quality, better quality of management

The quality competition regions of the world (USA, EU, Japan and its followers) in the last 100 years are searching continuously the way to TQM but they are doing it on different ways. (These different approaches rooted on different society cultures and the discrepancies among these ways are likely caused by the (quality of) culture.) According to my opinion, it also means that instead of better quality management the focus has to be on better quality of management to find the way to TQM in the interest of successful competitive operation and excellent business performance.

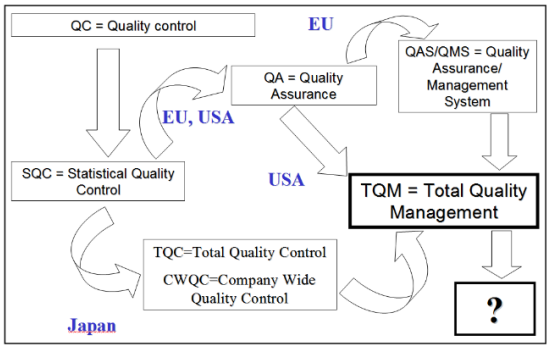

Figure 4. Way search of the quality systems to TQM in different regions [5]

The management always have to control that the organization is on the good way to TQM or not. For this the audits could provide a great overview about the organization.

3.3. Audits with new approaches

To increase the effectivity of the organization the roles of the audits should be increased. Especially the internal auditor should play a bigger role. They should give the primary sources of the continuous improvement and development what elevate the organization on "higher" level (see Fig. 5).

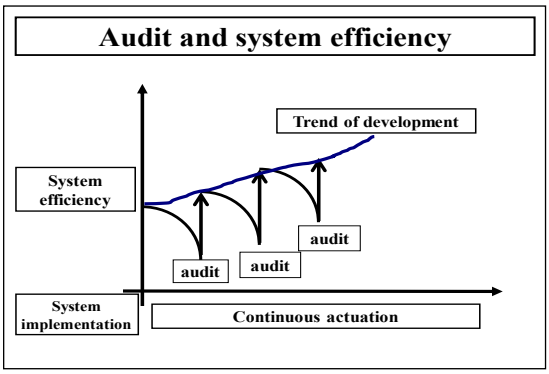

Figure 5. Audit and system efficiency [8]

However, for this the [8] internal audit should be understood and practiced on different way! First the audited and the auditor should have a common goal and it should be to increase the audited organization / system / business / enterprise competitiveness through continuous development and improvement.
Therefore, during the internal audit it is very important to identify the inappropriate processes and offer solutions for these issues and not just recording the actual appropriate well running processes. Viewed from this perspective the internal auditor's expertise and active role in proposing overwrite the independence criterion (but of course, during the third party audit the auditor has to be independent - it is a primary requirement.) So all in all do internal audits! – but on another way!

On one side, the auditor(s) should propose solutions for the long-term development and improvement processes and offer solutions for the problem prevention processes as well. On the other side they should approach the audit process on different way. The audits could be done according to the eight principles of the MSZ EN ISO 9000: 2005 (or the focus could be put on some major elements.) In this case the audit has to be done according to the follow eight principles:

1. Customer focus organization and operation,
2. Leadership,
3. Involvement of people,
4. Process approach,
5. System approach management,
6. Continuous improvement,
7. Fact based decision-making,
8. Mutually beneficial supplier relationships.

The management (or the auditors) has to find which principles are weak in daily life of the organization and these has to be audited. For example, the ISO 9001:2008 principle of continuous improvement must be audited in connection with the following system elements:

4.1 General requirements,
5.1 Management commitment,
5.2 Customer focus,
5.3 Quality policy,
5.6 Management review,
6.1 Provision of resources,
8.5 Improvement,
8.5.1 Continuous improvement.

Let the organization check systematically: whether these principles are in the documentations and in what form or are they in the related working orders and if yes in that case how these operate in practice (of course in one system element more principles may appear, these could be audited according to more principles!).
TQM-like audits guiding principle can be the well-known three principles (customer focus, the (processes), continuous improvement and development, the full employee empowerment) and their supporting elements (education, training; communication; flexible supporting organization; motivation, recognition; evaluation, measurement, analysis). They must be connected together with certain elements of the system during an audit (e.g. the related elements of continuous improvement and development).

As it was demonstrated in a previous table, the thematic key elements of the TQM oriented, and therefore more stable and long-term focused, third dimension" quality conscious management environment is the 12 points of TQM (see Tab. 1).

To this American approach is close the German-based 5M, 7M, 9M perception what says: the key elements of a well-managed quality-conscious system are the follow:

1. Men
2. Management
3. Method
4. Material
5. Machine
6. Milieu
7. Motivation
8. Maintenance
9. Money.

Audits could be done based on these elements or again the weak points of the organization has to be determined and these points have to be audited.
The departments, the key elements, the principles has to be brought into line with the standards and the quality system of the audited organization and the audit has to be done according to this process.

4. HOW TO GO FURTHER? WHAT TRENDS SHOULD BE FOLLOWED AND HOW THE DOMESTIC QUALITY MODEL SHOULD LOOK LIKE?

Globalization caused that neither the American nor Japanese nor European quality management systems could be applied alone. A mix of these quality systems have to be applied then it has to be operated and audited but how it should look like?
What could be the basic practice elements of the domestic quality model based on the above analysis? What key elements could be implemented from the 3 approaches (see Fig. 4) into the operations of domestic quality-conscious system and which systems could be best utilized to improve the domestic quality management systems?

1. Focus on the quality management and the quality control instead of the quality assurance and quality check. This requires that the whole system has to be in the focus of the operation not just the formal quality department and its employee. Everybody in the organization has to be responsible for the quality of its activities, and its continuous improvement-development.
It also requires that in mentality of the top management and practical activities the quality thinking / quality consciousness has to be appear and the quality has to part the daily activity of an adequate number of employee in all departments.
2. The system set up and establishment has to be very stable, massive. Significantly longer time needed to deepen the system operation and its continuous operation, improvement and development. In my opinion this requires more time than what is usually spent in domestic systems. In the domestic systems the Hungarian companies reach the ISO 9001 certification and its quality level within 1-1,5 years while in Europe it takes 2-3 years [4]. More efforts and attentions have to be paid on the daily continuous operation processes and quality system development process than just a few internal audit and one management review between two external audits. But for this the employees have to be involved and they have to be trained to quality, they have to get the quality virus and they have to spread it as well. More and more employee have to be involved not only the employee of the quality department.
3. In the total system about 10-25% of employees have to be trained with the right, organization fit quality methods and techniques (e.g. "four simple", “the four best" or “the seven best" methods) and involve them into continuous improvement and development processes (CIP, PDCA, CQI).
This development and implementation requires a full systematic education and training program. Its execution -and finally the way of thinking change- will take minimum 3 years but 5 years is more realistic.
4. Minimum have a top management team, all key process have to have an expert team and a quality specialist and a methodology specialist. These teams have to have a team leader who has the needed decision making rights. The team leader should have a professional and personal prestige as well and have access to the needed resources to implement quality activities.
5. On the focus of the ongoing internal quality improvement has to be the complex error analysis what has to be build up on reliable data and information base, and with its help continuously reduce the level of errors and improve the "quality performance". Regular data collection, analysis, continuous feedback and control, continuous team activities and regular management evaluation of these teams, team motivation are needed and of course, the setbacks, failures, nonconformities has to be regularly reported as well.
6. The aim of the operation has to be to reach the “zero-error” level what based on a “third generation” regulated system basis. This requires the knowledge of the current level of capability. The common continuous development goals have to be determined and the employees have to be motivated in line with the common goals.
7. The deliverer level should be the "second generation" middle professional management level.
The middle level managers should have the suitable position and/or the suitable professional prestige. They should manage the daily continuous development and improvement process and they should represent their quality commitment in the practice as well.
8. Establish American-minded "management climate." It means for the top management the management itself has to shows example of the high quality of its activities, commitment to quality and its practical implementation. Management has to provide the necessary work conditions and resources for quality work and motivate the employees, adhere to the quality requirements and require it from the suppliers and provide for the customers.
9. Operate and empower the teams on "Japanese" way, prepared them with the necessary knowledge and PDCA understanding but for this process first the management has to prepare all the conditions for the

quality work than they could require the quality work from employees. Educations and trainings has utmost importance in this activity.
10. The final objective is try to reach a TQM-like operation. This requires that for the practical cases in the specific system adapt the principles of TQM. In my opinion it means that primarily the TQM basic principles of continuous improvement and development has to be established. More and more employees has to be involved in quality development processes (suggestions, ideas request; education training, contribution to team works. involvement into the goals set up, continuous presentation of quality system etc.).

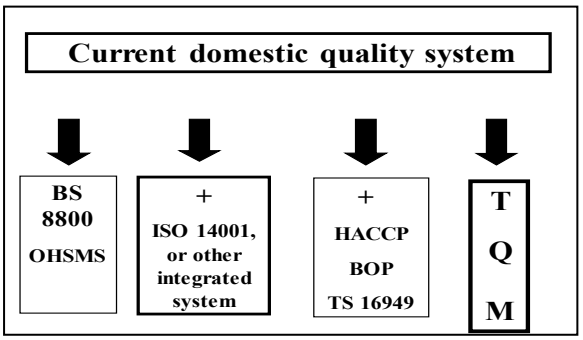

Figure 6. Possible development ways to the domestic quality model

Some other recommended weighted criteria resulting from the foregoing:

Table 3. Weighted order of TQM principles [4]

Three TQM principles	
1. Continuous development and improvement.	Minimize the gap between the plan and the results and continuously improve and develop the processes.
2. Employee empowerment.	Every level of the organization has to be involved into the decision making process.
3. Customer focus.	Identification of the external and internal customer demands and fulfillment of these.

Table 4. Weighted order of ISO 9000 principles [4]

Minimal required quality system	
Fundamental objective	***Required quality system***
Meet the specifications	Quality control
Meet the function requirements	Statistical quality control
Meet the evident customer demands	Total quality control
Meet the hidden customer demands	TQM
Meet the environmental and society demands	Integrated systems

Table 5. The connection of the quality system and fundamental objectives [4]

Four from the eight principles of ISO 9000:2005
1. Continuous development and improvement.
2. Leadership skill of management.
3. Employee empowerment.
4. Customer focused organization and operation.

Today quality management is already able to provide help to the management to choose which quality system best fits to the organizational / corporate goals and in the same time it points out that what is the connection between the "total" management and the quality management all in all the quality management system has to fits to the organization goals.

5. CONCLUSION

Clear Japan, American, European solution is not exists. Due to the globalization mix quality systems are growing up. Basic elements (see Tab. 2) and quality systems (e.g. see Fig. 6) are existing but always the management has to decide which basic elements and how could support the spread of the quality virus to reach the best organization goals.
The quality virus is not a simple virus in the body of the organization. It is itself the life. According to Scheele, president of Ford Motor Company [1]: The perfect is already not enough. Those companies what are let the quality virus to spread everywhere in the organization and in its environment will be successful in long term the other uninfected companies will be out of the market soon.
The main reason of it is that all the customers are already infected with the quality virus and they are looking for products and services what are created only by VICs virus infected companies. The others in long term are definitely not welcome anymore.

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MATHEMATICAL MODEL TO DETERMINATION OF THE RESHARPENING TERRITORY OF CONICAL HOB

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ABSTRACT

Based on the general mathematical model of Illés Dudás which is appropriate for mathematical modelling of production technology methods we have worked out a model for resharpening analysis of conical hob. After the hob resharpening using numerical calculations the determination of the tooth surface of face gear by cutting edges is necessary for the analysis. Based on this methods we could calculate the permissible critical angle of the hob and the profiles of the hob and the face gear in axial section. The permissible critical angle of the hob is the critical angle the hob cutting edge of which manufactured face gear profile is situated in the permissible profile error tolerance. We have worked out a new geometric conical worm gear drive that is the conical worm gear drive having arched profile. Using this mathematical model we have done resharpening analysis for the hob having arched profile and determined the permissible critical angle.

Keywords**:** hob, face gear, mathematical model, resharpening

1. INTRODUCTION

The teething of a face gear is determined by the teething of the worm with contact surfaces mutually meshing with each other.

The teething of the worm, such a tool should be applied so that its cutting edges are situated on the surface of a substituting worm (Fig. 1) [3]. It is necessary so that the production tolerances could be provided.

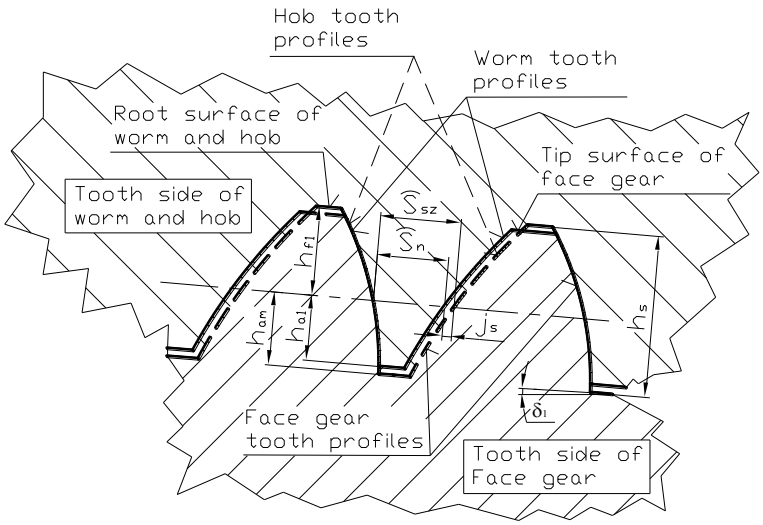


Figure 1. The basic profile of the face gear hob

The elements of the face gear hob is equal with the elements of the worm co-operating as a gear drive with the face gear by direct motion mapping [3]. Tip diameter and tooth thickness of the hob is larger than the parameters of the real worm because of the assurance of resharpening territory and backlash between the worm and the face gear (Fig. 1).

Based on these it could be determinable the equation of the hob cutting edge has to be known to determination of the tooth surface points of the spiroid face gear [2].

2. DEFINING OF THE HOB CUTTING EDGE AND THE FACE SURFACE OF THE HOB

Given the $\vec{r}_g(\xi,\eta,\zeta)$ generator curve of the B helicoidal surface having parameters p_a (axial) and p_r (radial thread) in the form (Fig. 2)

$$\vec{r}_{1F}(\eta,\vartheta) = M_{1F,sz} \cdot \vec{r}_g \tag{1}$$

$$\left.\begin{aligned} x_{1F} &= \xi(\eta)\cdot\cos\vartheta - \eta\cdot\sin\vartheta \\ y_{1F} &= \xi(\eta)\cdot\sin\vartheta + \eta\cdot\cos\vartheta + p_r\cdot\vartheta \\ z_{1F} &= \zeta(\eta) + p_a\cdot\vartheta \end{aligned}\right\} \tag{2}$$

which could be random profile (line, circle, elipse, parabola, etc.).

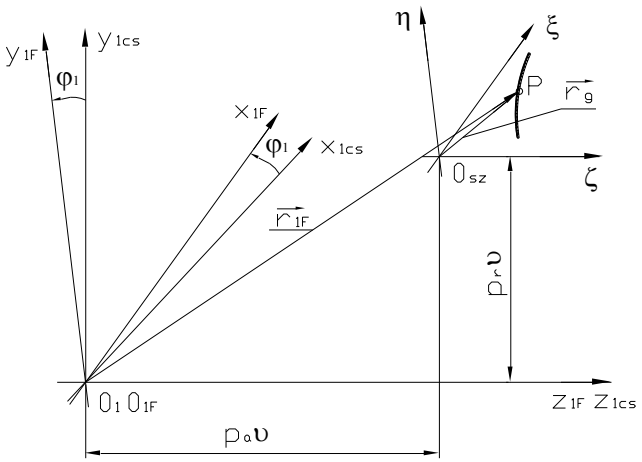


Figure 2. Defining of conical helical surface

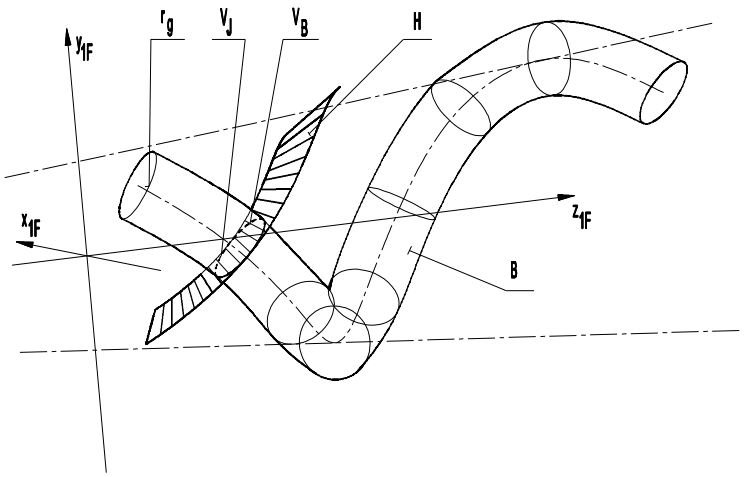


Figure 3. The generation of face surface H and cutting edges V [3]

To face surface H is a ruled (closed and flat) helicoidal surface with a generator line perpendicular to the axis of surface B showing a lead direction perpendicular to the lead direction measured on the pitch cone of helicoid B (Fig. 3)

$$\vec{r}_{1F}^{\,H} = \vec{r}_{1F}^{\,H}(\eta,\vartheta)\ . \tag{3}$$

The common solution of the equations of the worm surface (B) and the face surface (H) result the profile points of the cutting edge of the hob (V) (Fig. 3) [3], that is

$$\left.\begin{aligned}\vec{r}_{1F} &= \vec{r}_{1F}(\eta,\vartheta)\\ \vec{r}^{\,H}_{1F} &= \vec{r}^{\,H}_{1F}(\eta,\vartheta)\end{aligned}\right\} \quad \vec{r}^{\,V}_{1F}(\eta',\vartheta)\,. \tag{4}$$

Let the parameter of the relief thread surface be $p_a^{'}$ based on (2) the equations of the back surface of hob are:

$$\left.\begin{aligned}x_{hr} &= \xi(\eta)\cdot\cos\vartheta - \eta\cdot\sin\vartheta\\ y_{hr} &= \xi(\eta)\cdot\sin\vartheta + \eta\cdot\cos\vartheta + p_r\cdot\vartheta\\ z_{hr} &= \zeta(\eta) + p_a^{'}\cdot\vartheta\end{aligned}\right\}\,. \tag{5}$$

3. MATHEMATICAL MODEL TO DETERMINATION OF THE TOOTH SURFACE POINTS OF FACE GEAR DURING HOB RESHARPENING

Knowing the $\vec{r}^{\,V}_{1F} = \vec{r}^{\,V}_{1F}(\eta',\vartheta_1)$ two parametric vector scalar function of the hob cutting edge (meshing surface) our objective is to generate the tooth surface points of the face gear during resharpening along the face surface of the hob.

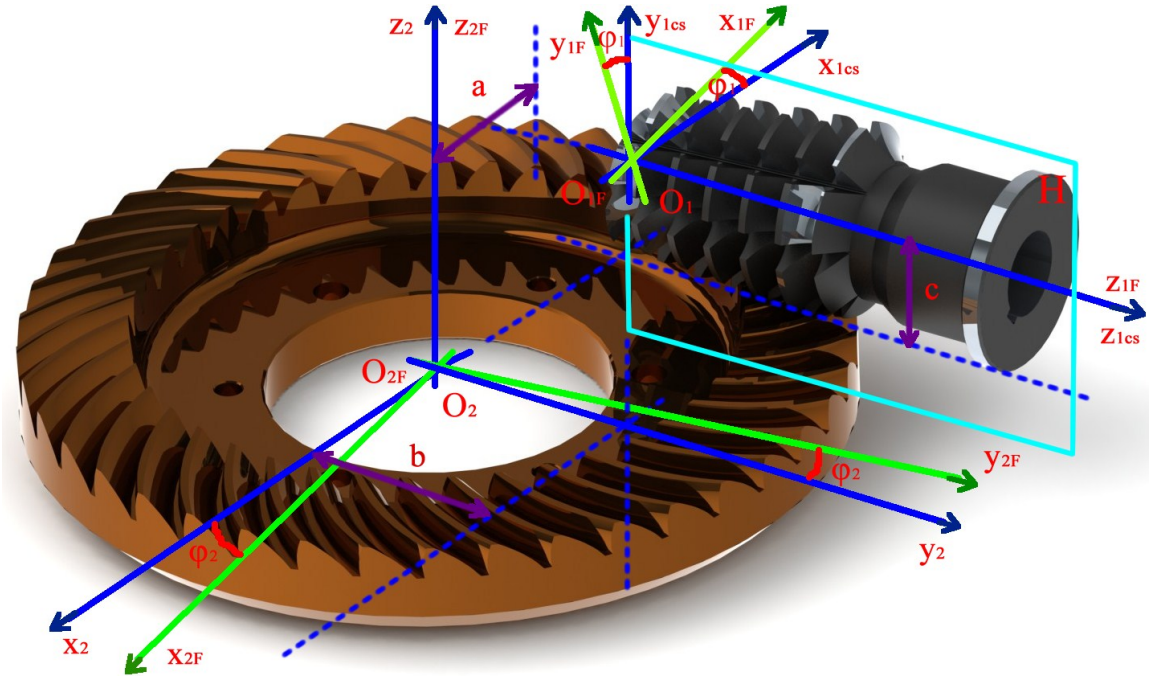


Figure 4. The position of spatial coordinate systems to determination of the tooth surface points of the face gear

For the description of the motion relations we define the own motion of each coordinate system (Fig. 4). Thus K_{1F} (x_{1F}, y_{1F}, z_{1F}) coordinate system rotates with

$$\vec{\omega}_1 = \frac{d\varphi_1}{dt} = const. \tag{6}$$

angular velocity in K_{1cs} (x_{1cs}, y_{1cs}, z_{1cs}) stationary coordinate system [3, 4, 5].

The K_{2F} (x_{2F}, y_{2F}, z_{2F}) coordinate system in the K_2 (x_2, y_2, z_2) coordinate system rotates with

$$\vec{\omega}_2 = \frac{d\varphi_2}{dt} = const. \tag{7}$$

angular velocity [3, 4, 5].

Transformation matrix between the K_{1F} (x_{1F}, y_{1F}, z_{1F}) rotational coordinate system fixed to member 1 and the K_{2F} (x_{2F}, y_{2F}, z_{2F}) rotational coordinate system fixed to member 2 (Fig. 4) is:

$$M_{2F,1F} = M_{2F,2} \cdot M_{2,1cs} \cdot M_{1cs,1F} =$$

$$= \begin{bmatrix} -\cos\varphi_2 \cdot \cos\varphi_1 & \cos\varphi_2 \cdot \sin\varphi_1 & \sin\varphi_2 & -a \cdot \cos\varphi_2 + b \cdot \sin\varphi_2 \\ \sin\varphi_2 \cdot \cos\varphi_1 & -\sin\varphi_1 \cdot \sin\varphi_2 & \cos\varphi_2 & a \cdot \sin\varphi_2 + b \cdot \cos\varphi_2 \\ \sin\varphi_1 & \cos\varphi_1 & 0 & c \\ 0 & 0 & 0 & 1 \end{bmatrix} . \tag{8}$$

3.1. Application of the direct kinematical method to generation of the tooth surface points of the face gear

Given the $\vec{r}_{1F}^{V} = \vec{r}_{1F}^{V}(\eta', \vartheta_1)$ two parametric vector – scalar function of the hob cutting edge in the K_{1F} (x_{1F}, y_{1F}, z_{1F}) rotational coordinate system of the hob [2].

In the K_{1F} coordinate system the normal vector could be calculated [3, 5]:

$$\vec{n}_{1F}^{v} = \frac{\partial \vec{r}_{1F}^{V}}{\partial \eta'} \times \frac{\partial \vec{r}_{1F}^{V}}{\partial \vartheta_1} \tag{9}$$

The relative velocity between the two surfaces can be defined by the transformation between the K_{1F} rotational coordinate system of the hob and the K_{2F} rotational coordinate system of the face gear in the K_{1F} system:

$$\vec{v}_{1F}^{(12)} = M_{1F,2F} \cdot \frac{dM_{2F,1F}}{dt} \cdot \vec{r}_{1F} \tag{10}$$

where

$$P_{1k} = M_{1F,2F} \cdot \frac{d}{dt}\left(M_{2F,1F}\right) \tag{11}$$

matrix of the kinematic motion mapping:

$$P_1 = \begin{bmatrix} 0 & -1 & -i_{21} \cdot \cos\varphi_1 & -b \cdot i_{21} \cdot \cos\varphi_1 \\ 1 & 0 & i_{21} \cdot \sin\varphi_1 & b \cdot i_{21} \cdot \sin\varphi_1 \\ i_{21} \cdot \cos\varphi_1 & -i_{21} \cdot \sin\varphi_1 & 0 & a \cdot i_{21} \\ 0 & 0 & 0 & 0 \end{bmatrix}. \tag{12}$$

Knowing the Connection I. Statement and the equation of the hob cutting edge (4) the tooth surface points of the face gear by cutting edges are the common solution of the below equations:

$$\left.\begin{aligned} \vec{r}_{1F}^{V} &= \vec{r}_{1F}^{V}(\eta', \vartheta_1) \\ \vec{n}_{1F}^{V} \cdot \vec{v}_{1F}^{V(12)} &= 0 \\ \vec{r}_{2F} &= M_{2F,1F} \cdot \vec{r}_{1F}^{V} \end{aligned}\right\} . \tag{13}$$

Using the received equations (13) for example we have done resharpening analysis for the our worked out, new geometric conical worm gear drive having arched profile in axial section [1]. On Fig. 5 it could be seen the hob face surface is situated in the axial section.

We have done computer program to the analysis (Fig. 6). As a result considering of the profile preciseness of the face gear we have received the permissible critical angle of the hob υ_{hat}=5° (Fig. 5 and 6).

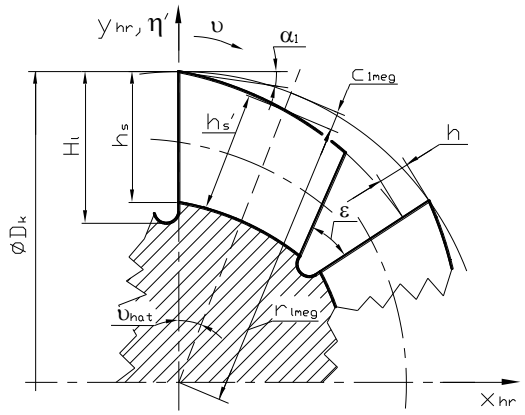
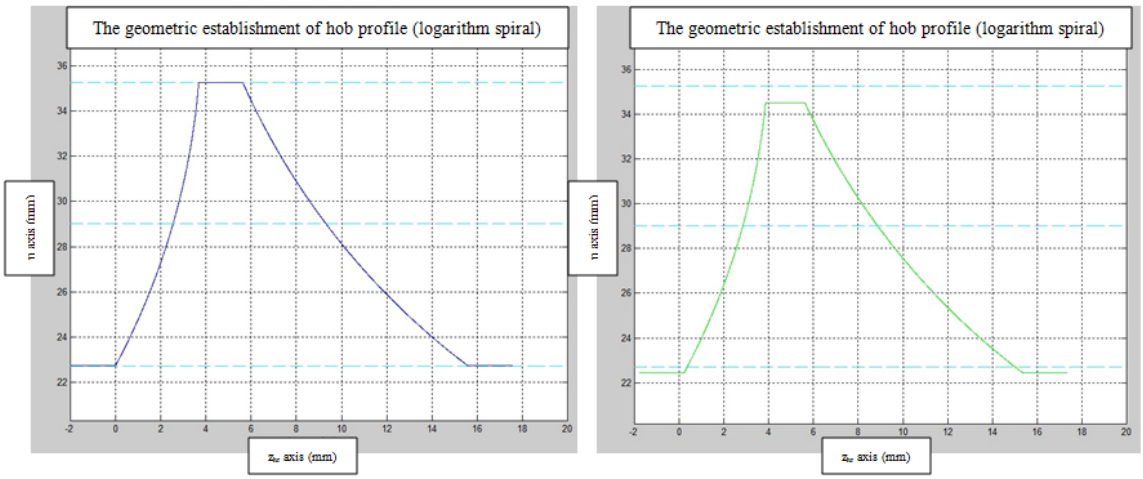


Figure 5. Definition of the permissible resharpening provision and the resharpening critical angle of the hob



a) υ=0° b) υ=5°

Figure 6. The geometric establishments of hob cutting edges

4. CONCLUSION

Based on the general mathematical model of Illés Dudás [3] we have worked out a model to determination of the tooth surface points of the face gear which are generated by the hob cutting edges in discreet resharpening angle position.

Based on the permissible profile tolerances of the face gear and the hob the resharpening critical angle of the hob could be determined in the hob axial section.

This is the critical angle the hob cutting edge of which manufactured face gear profile is situated in the permissible profile error tolerance. Consequently it is correct in case of operating.

For example we have shown in our results for the hob cutting edge on Fig. 6.

ACKNOWLEDGEMENT

The development of the production technology and the real production process of the conical worm gear drive and the hob having arched profile in axial section are occurred in the **DifiCAD Engineering Office Ltd.** (Miskolc, Szentpéteri Gate 5-7.) (Fig. 7). Director: **Dr. Illés Dudás**.

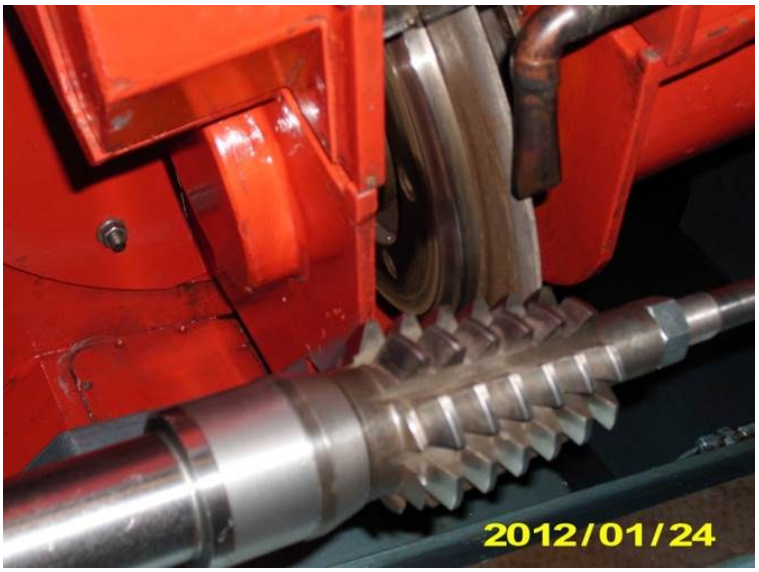


Figure 7. The hob backward grinding could be seen on this figure (DifiCAD Engineering Office Ltd.)

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MOTIVATIONS, ATTITUDES, CONSUMER HABITS ON THE PRODUCTION AND CONSUMPTION OF WINE IN SOLTVADKERT

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ABSTRACT

Soltvadkert is a little city between the Danube and Tisza rivers. In 1700s years was the first initiative to plant grape and now, Soltvadkert is can be proud of the award "The City of the Grape and Wine". In our research, we used making of structured interview from primer methods. Five wine-makers were asked to know their opinion about the actual situation. We made a quantitative survey also, 100 inhabitants and 100 tourists have filled our questionnaire. The consumption habits linked to the wine, the knowledge about the winemakers of Soltvadkert, the wine-purchasing habit. The result of this survey is the SWOT analysis, which we made and show in this article The main weaknesses of the sector are: the wine forgery scandal, and the not too good level of the vine-consumption.

Keywords: winemakers, wine forgery scandal, qualitative survey, quantitative survey

1. INTRODUCTION

Soltvadkert is a little city between the Danube and Tisza rivers. Lőrinc Orczy baron was the first one, who ordered the grape-installation in the middle of the 1700s years [3]. In 1880s years the phylloxera epidemic has an effect on these grape, because the most of the mountain grapes was destroyed, so the role of the grape vines was revalued. In the end of the 1880s, Fülöp Krämer, the famous cellar master of Buda, travelled to Soltvadkert. He liked the sandy area - near the railway station, so he bought a big agricultural land to produce wine. He made a lot of innovation, for example, he was the first man who used the secateurs – instead of knife. After a few years he as a local habitant started there the vine- and wine-production [5].

During the 2nd World War the most part of the vine was ruined, and after the war in the 1950s the compulsory delivery system was the main enemy of the wine production [3].

In 1949 were established three, in 1950 was established other cooperative farms. They were nonviable, because the leaders wanted to produce arable plants; however it was impossible in the sandy land. The area and the workers of the 4 cooperatives farms was not enough to the economical producing, so they were merged. In 1960s they started to develop the wine-production [7]. The most effective company was the "Jóreménység". Before the regime change the crisis reached these farms, and the constriction of the Soviet market exacerbated the situation [6].

After the change of the political system, the small farmers have strengthened, because of the farm-structured changed [7]. Wine-grower association was established in 1995, Soltvadkert. This association helped farmers to manage the official relation and the attending in fellowships [3]. Last year's Soltvadkert wine grower association became the biggest one in Hungary. 3150 ha grape are cultivated near Soltvadert as it published by [4].

In 2002 the Danube Wine Region was established by Csongrád, Hajós-Baja, and Kunság (including Soltvadkert) wine growers, what possess the biggest vine-grower area in Hungary. Plantations located on the Danube Wine Region gave the 40-50 percentages of the Hungarian grapes production in [1].

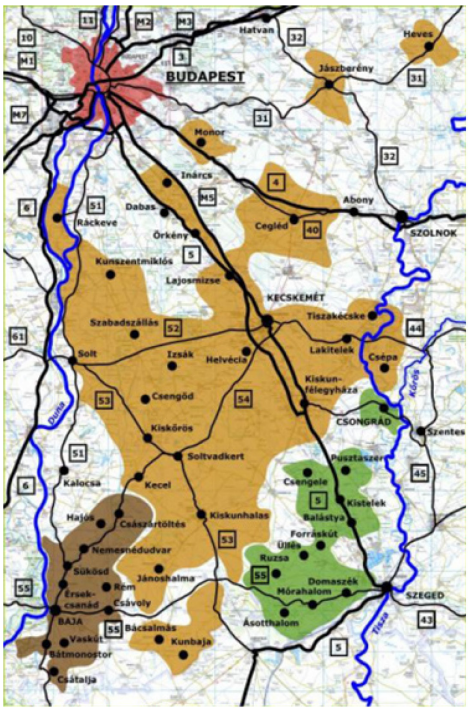

***Figure 1. The map of Danube Wine Region** [9]*

In 2001 the Krämer Fülöp Brotherhood of the Knights was founded, commemorating a famous domestic wine-grower [3]. János Frittmann, one of the famous Hungarian wine growers by the Hungarian Academy of Wine received the award "Wine Growers of the Year" in 2007 [2]. In 2008 Soltvadkert got the award, "The City of Grape and Wine" as the 42th members of the Hungarian Grape and Wine Cities Association [8].

2. MEANS AND METHODS

A structured interview was made at first as a basic element of the primer research process. During the research we could meet major representatives, experts of this wine region what was very useful to understand the traditions and the importance of the grape growing. Interviews were made with the managers of Frittmann Brothers Ltd., Erdős Vinery Ltd., Galántai Family Vine Cellar, Solt-Vin Ltd. and Lantos Vinery.
The second method was the questioner survey. 100 inhabitants and 100 tourists were asked by the survey. The special events and festivals were excellent possibilities for collecting data.
The questionnaire consists of 4 parts. The first part contains question for the general consuming of alcoholic beverages while the second one only for consumption of vine. In the third part we wanted to collect data about the knowing of wines of Soltvadkert region and the last part contained the demographic data. Data were analysed by Statistica for Windows 11 software.

3. RESULTS AND DISCUSSION

3.1. Main findings form the winemakers' interviews

Many winemakers use Hungarian grape varieties taking advantage that wines made from this grapes are "Hunaricums". The results of Hungarian wines at International Wine Competitions prove the truth of this decision.
Many problems rose up during the last 25 years independently the development:

- Serious market anomalies what are caused by the cheap Italian wine import
- Erratic weathers,
- Huge administrative burden

- Dramatically decrease of wine-consumption, due to wine adulteration in 1990's in Hungary.
- This case wasn't treated well by media focused mainly in Soltvadkert wine region.

Experts considers the quality improvement of wines very important and the publishing the results of wine contests in newspapers also very effective tool. Winemakers place greater emphasis on the wine tourism and they draw attention the importance of the festivals, wine competitions and wine tastings.

3.2. Results of the quantitative survey

The demographic data of 200 asked persons is demonstrated in Tab. 1.

Table 1. Demographic data of the asked people (n=200)

(Parameters)	Capita		Percentage (%)	
	Tourist	Local	Tourist	Local
Gender				
(man)	54	44	54	44
(woman)	46	56	46	56
Residence				
Bács-Kiskun count	22	100	22	100
Budapest	52	-	52	-
Transdanubium	12	-	12	-
Trans Tisza region	14	-	14	-

The following results can be outstanding. All participants consume alcoholic beverages mainly responses were: regularly or occasionally. Remarkable part of respondents prefers wines among the alcoholic beverages. Most of them drink mainly dry, white wines (Fig. 2).

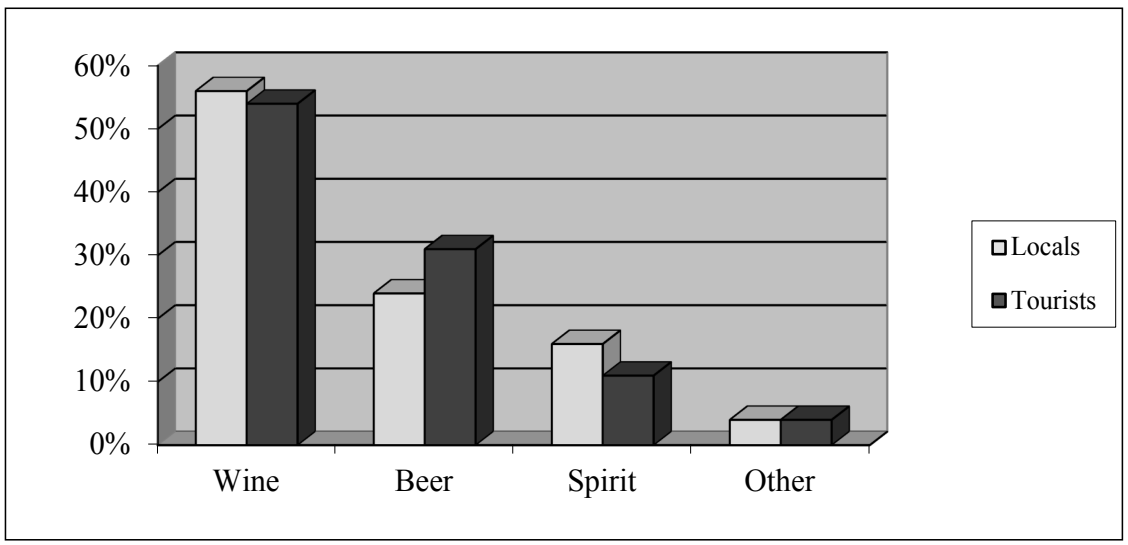

Figure 2. The distribution of the answered by the most consumed alcohol (n=100-100)

The popularity of white and red wine was similar but the local people rather drink red wine and the tourists drink white wine as their favourite ones. Extremely high ratio of respondents stat that they drink Hungarian wines, actually 96% of inhabitants, and 90% of tourists.
Strong parochialism was explored during the questionnaire because the inhabitants drink wines from Hungarian Great Plain remarkably higher ratio than tourists (Fig. 3). The success of the local wine-makers

is well known among local residents, but only the 65% of the tourists have heard about it. The best known wine-makers are Frittman brothers.

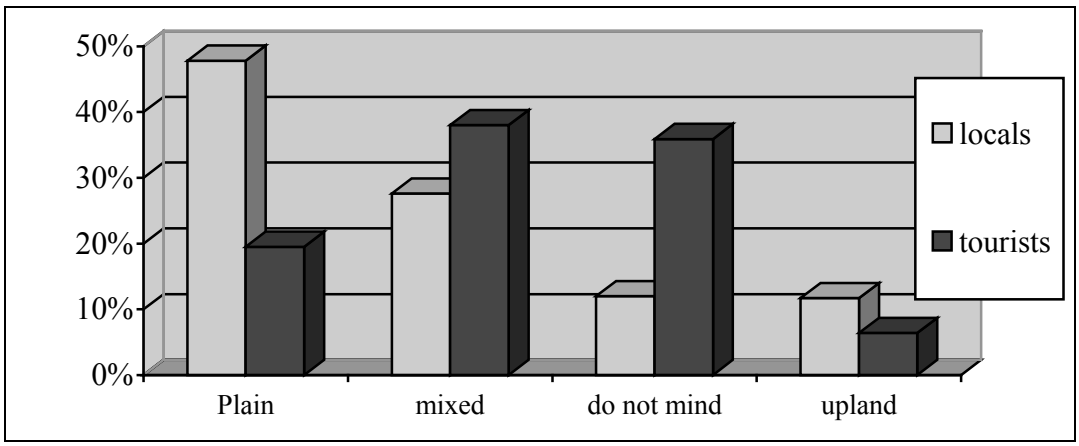

Figure 3. The distribution of the answered by consumed wine basic on the region, n=100, n=100)

We examined the difference between men and women, so let's see some interesting gap. Men drink alcohol more times than women. However men and women all like the dry wine, but women wrote on the 2nd place the sweet wine, man wrote the semi-sweet. There is a difference in the consumption of the Soltvadkert wine also, because women tourists had never drunk it yet, but the 37 % of the men tourists often had drunk it. Vey interesting this fact: local men know about the success of wine from their friends (in the pub), women know it from the news on the TV or Internet.

4. CONCLUSIONS

Based on our research, we made a SWOT analysis (Tab. 2).

Table 2. The SWOT-analysis of the wine and vine-production in Soltvadkert

Strengths	Weaknesses
The tradition of the wine and vine-producing Good quality of the vine Famous and respected winemaker in the city Big wine-area near to the city The most biggest "mountain village" in the country Using of typical plan-wine	Wine forgery scandal To be out of interest of media – in case of successful Not too good level of the vine-consumption The low level of the marketing activity
Opportunities	**Threats**
Open to the export market Increasing of the Hungarian vine-consumption Development of the vine-tourism Using of the application Formation the social class of the quality vine-consumption	Increasing of the import Anomalies of the market Bad economy situation The fluctuation of the quality – because of the weather Increasing of the administrative burdens

Our proposals are:

- Winery must find their target market. Based on our research, the Frittman Brothers would be for the local inhabitants, Galántai Winery for the women tourists, and the Erdős Winery for men tourists.
- Tourist visit Soltvadkert primarily because of the Vadkert Lake, so it would be useful to organize more festival near the lake – in summer.

- The winemakers should upload some scientific article into their homepage, to convince consumers of the healthy nature of the wine.
- The wine tasting will be very useful, not only has to know the difference among the different type of wines, but also to present to the laymen some special technology steps.
- The food exhibition and the export markets would be good opportunity to become famous product in other countries also.

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OPTIMIZATION OF THE EXTRACTION PROCESS IN ORDER TO ISOLATE ANTIOXIDANT COMPOUNDS FROM WALNUT LEAVES

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ABSTRACT

In the popular perception, nuts were considered to have high content of fats and therefore were seen as unhealthy foods, which are indicted in different cardio-vascular diseases or diabetes. This perception has changed after the lately researches, which proved their healthy fatty acid profile of the walnut and its products. The walnut (*Juglans regia L.)* consumption is now associated with a reduced risk of coronary heart diseases, cancer and all other oxidative stress mediated diseases. Different studies had shown that the walnut leaves contain several phenolic compounds which contribute to their biological properties. Researchers are focused on walnut because it contains an important phenolic compound called juglone and it is used in the treatment of inflammatory and infectious diseases. They also inhibit the Gram positive and Gram negative bacteria and also fungi.
The present research has the priority to establish the proper method of extraction using walnut leaves and a mixture of solvents in different volumetric proportions. Primary the walnut leaves were extracted with a mixture of ethanol and water in proportions 50:50; 60:40; 70:30; 80:20. After the extracts were obtained, they were concentrated and the final extract was used to analysis.

Keywords: walnut leaves, antioxidant properties, heart diseases.

1. INTRODUCTION

A healthy diet must include several foods that contain essential fatty acids and also an important amount of antioxidant compounds. Walnuts (*Juglans regia* L.) possess one of the highest antioxidant capacity, therefore it is recommended to consume these nuts daily. The benefits of walnuts consumption consist in the protection for cardio-vascular diseases by decreasing LDL-cholesterol and increasing HDL-cholesterol (Bernal et al., 2011), normalizes the level of blood glucose and prevention of the harmful effects of the free radicals.
The increased interest in foods and supplements obtained from plants which contain high amounts of antioxidant compounds is the basis for further researches that proved the chemical composition and bioactive properties. Therefore the process of extraction must be improved to the highest capacity using modern techniques and materials.
The walnut leaves are believed to have an important role in maintaining a normal level of blood glucose, even decreasing it (Hasan et al., 2011). A recent study showed that the methanolic extract of Juglans regia's leaves decreases the level of blood glucose on diabetic rats and also human due to the capacity of walnut compounds to regenerate β-cells which are insulin-producers (Teimori, 2009).
Several researchers analysed the influence of different solvents on the antioxidant capacity in the extraction process. They proved that it is a strong connection between the solvent used in the extraction and the antioxidant properties and extraction yield, based on the different polarity of the compounds obtained (Fernandez-Agullo et al., 2012).
An important compound contained in walnut leaves is *juglone* (5-hydroxy-1,4-naphthoquinone), a quinone with a powerful cytotoxic activity and it has been proved that its action mechanism is DNA intercalation or it acts like an alkylating agent.
An important property of the walnut leaves is the antimicrobial activity which is dependent with the concentration of the extract, therefore for a low concentrated extract no inhibition of the bacteria is found (Pereira et al., 2007). In the extraction process the concentration and solvents occupies a central role, and the optimization of this process must take into consideration these two factors.

2. MATERIALS AND METHODS

Materials. The plant parts used for the present study were fresh walnut leaves harvested from Dobrogea county. They were naturally dried and after that procedure, were mixed with a food processor until a powder was obtained.

Methods. The extract was obtained from the powdered walnut leaves with a mix of solvents (ethanol:water) in four different proportions: 50:50; 60:40; 70:30; 80:20 by volume. For the extraction process it was used an ultrasounds water bath and after that the extract was concentrated with rotavapor and filtrated. The analysis carried on thus the obtained extract were:

1. Determination of the antioxidant capacity using the DPPH method.
2. Determination of flavonoids using the spectrophotometric method, reference substances were quercitin and rutin.
3. Determination of polyphenols using the Folin-Ciocalteu method, reference substances were gallic acid and tannic acid.
4. Determination of water content.
5. Determination of lipids using Soxhlet method.

3. RESULTS AND DISCUSSION

The effects of polyphenolic compounds are of great interest due to the antioxidant and antiproliferative activities. In the present study, the polyphenols determination assay proved that the highest concentration of compounds was extracted with the 50:50 solvent ethanol:water, as shown in Fig. 1. The 70:30 and 80:20 solvent ethanol:water extracts showed also a high level of polyphenols due to the higher ratio of alcohol. The variation of phenolic compounds is due to their capacity to dissolve in different solvents in different proportions.

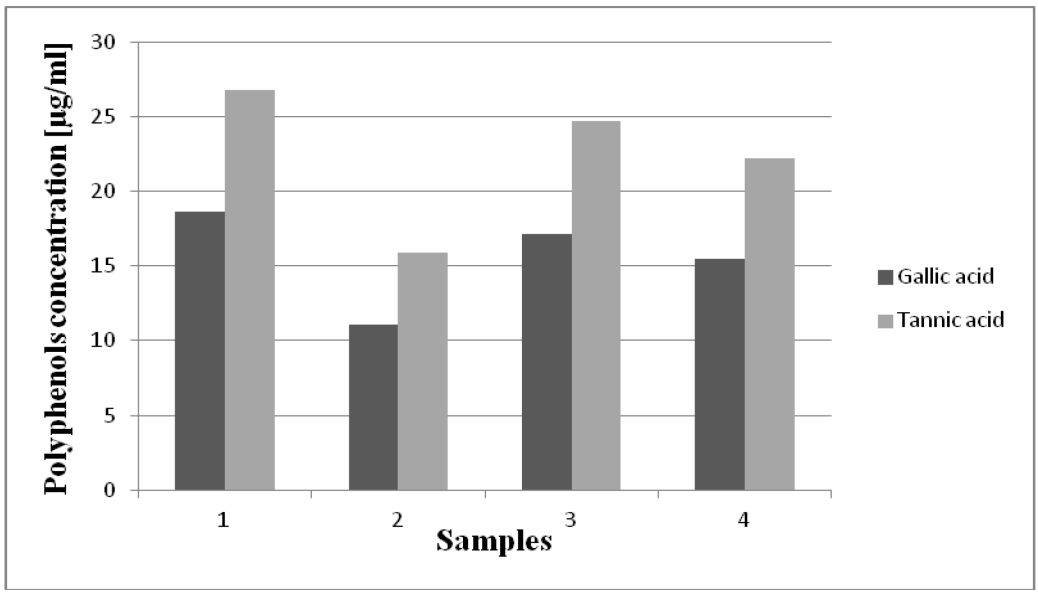

Figure 1. Variation of polyphenols in extracts with different solvents

1 - extract with ethanol:water = 50:50; 2- extract with ethanol:water = 60:40; 3 – extract with ethanol:water = 70:30; 4 – extract with ethanol:water = 80:20

Flavonoids are compounds that protect cells from free radicals effects which decrease the defense capacity of the human body. A recent research showed that flavonoids are able to replace vitamin E and their antioxidant capacity can depend on their chemical structure (Fernandez et al., 2010).
Researchers proved recently that flavonoids inhibit the LDL oxidation, therefore the antioxidant activity is situated in the top of the antioxidant substances.
The present study showed that flavonoids are influenced by the type and concentration of solvents in the extracts. In Fig. 2 it is revealed that the most powerful solvent is the one with the lowest concentration (50% ethanol). The quantities of quercitin and rutin is the highest in 50:50 ethanol:water extract of walnut leaves.

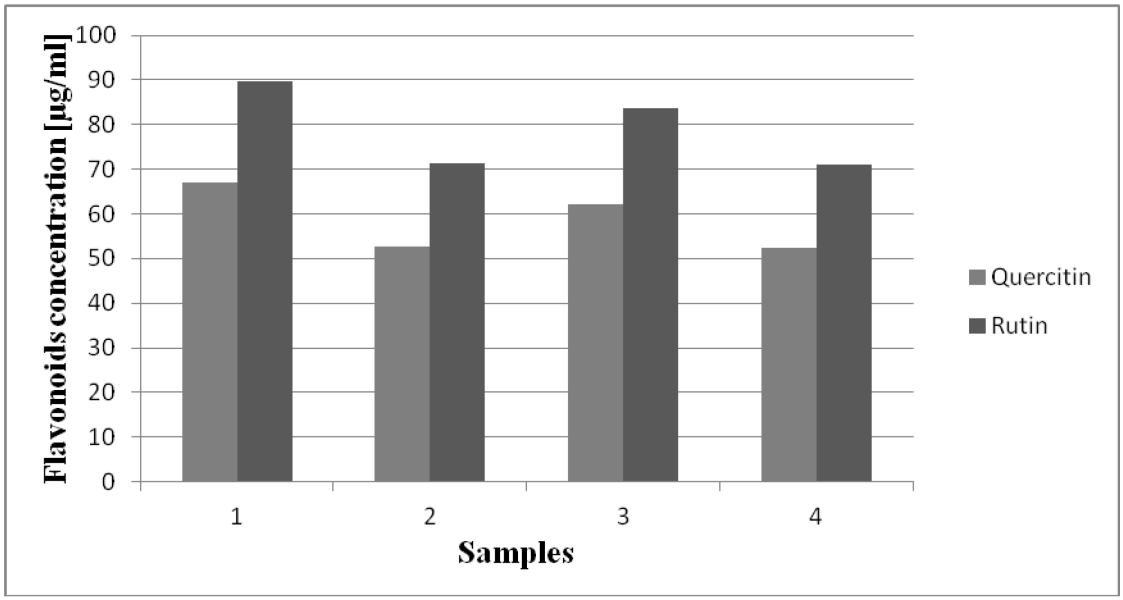

Figure 2. Variation of flavonoids in extracts with different solvents

1 - extract with ethanol:water = 50:50; 2- extract with ethanol:water = 60:40; 3 – extract with ethanol:water = 70:30; 4 – extract with ethanol:water = 80:20

The DPPH analysis for antioxidant capacity proved that the ability of walnut leaves extract to inhibit the free radicals is best highlighted with the ethanol:water solvent in proportion of 50:50. A high antioxidant activity is also showed by the 80:20 ethanol:water solvent extract, as it is shown in Fig. 3.

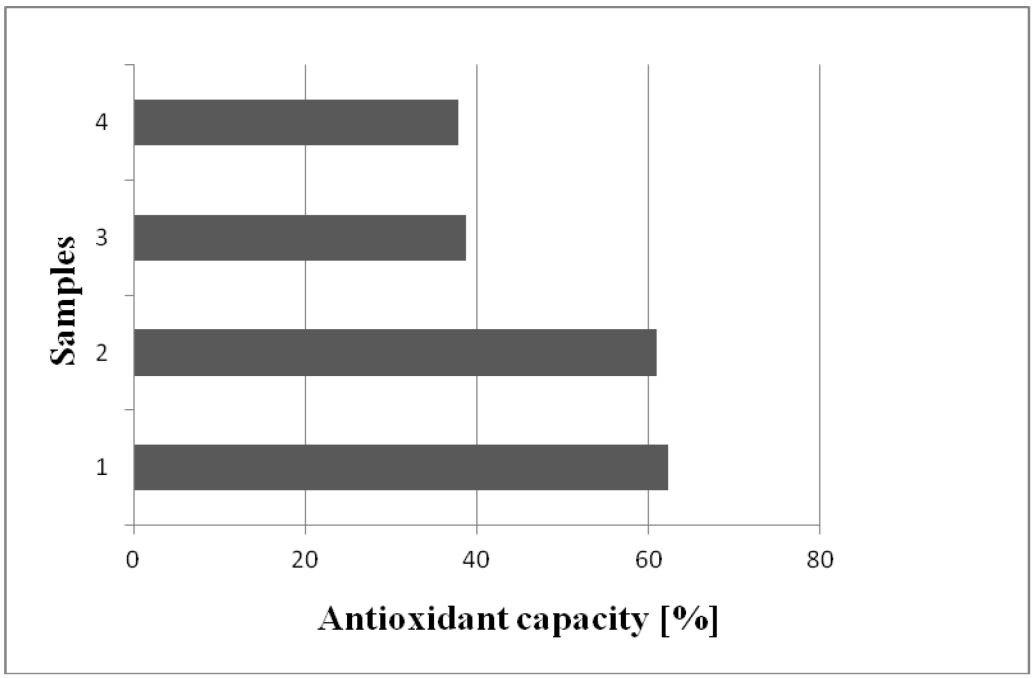

Figure 3. Variation of antioxidant capacity in extracts with different solvents

1 - extract with ethanol:water = 50:50; 2 - extract with ethanol:water = 60:40; 3 - extract with ethanol:water = 70:30; 4 - extract with ethanol:water = 80:20

4. CONCLUSIONS

The walnut leaves can be extracted with different mixes of solvents and the most appropriate were proved to be mixes of ethanol and water. The best ratio of these two solvents is 50:50 by volume, because as it was shown, it has the highest levels of polyphenols, flavonoids and antioxidant capacity. The 80:20 ethanol:water solvent appears to be also a good option for the walnut leaves extraction, showing that it almost reaches the values of the 50:50 solvents.

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POSSIBLE INFLUENCE FACTORS OF TECHNICAL TOLERANCE

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ABSTRACT

Legitimate users of agricultural areas can receive land-based payments based on the area of either the cultivated plants or the uncultivated land kept, in line with the provisions of community and national legislation, in condition eligible for support. Furthermore, land-based support can be received via other rural development measures as well.According to European Commission regulation the appropriate and eligible claim of the land-based supports shall be controlled by the member states. The most robust technique of this process is the remote sensing control. The observed discrepancies shall be sanctioned based on their extent and intentional nature. A measurement tolerance interval shall be set in case of remote sensing operations so that the extent of discrepancy is to be determined in the most objective way possible. As far as the measurement tolerance interval is concerned the goal is to minimise the cumulative faults appearing during the measurements (such as the scale of agricultural activities, the inaccuracy of farmers' drawings necessary for the claiming of support and the inaccuracy of control materials and methods).The establishment of the measurement tolerance interval is based on the fact that the reference parcels selected by the validation protocol are made by several operators in iterations. As a result of this process the following conclusions can be drawn:The validation method of multi-level tests required by the Joint Research Centre (JRC) properly detects the measurement results strongly affected by faults. Although this method is to be used exclusively to determine the technical tolerance in the Control with Remote Sensing (CwRS) process of the Integrated Administration and Control System (IACS), as independent validation process it does not take the further imagery and other vector references into account. In our examination we assessed the possible inclusion of the smallest identification unit of the Land Parcel Identification System (LPIS) – i.e. the physical block – as well as its impact on the value of technical tolerance.

Keywords: technical tolerance, orthoimagery, validation, LPIS, CwRS

1. INTRODUCTION

The Integrated Administration and Control System (IACS) is a tool used by the European Commission and EU member states to carry out checks on payments granted to farmers for particular crops and livestock based on the Land Parcel Identification System (LPIS) [1], [2], [3], [4].
The aim of the IACS is to establish, coordinate and control the payment processes. By the form of the so-called e-application LPIS provides opportunity for farmers to delineate by drawing their cultivated areas. It is also possible to enter the relevant attributes of the polygons created in such way. Among others these attributes are the code of use (the plant species grown in the given year), parcel size, other support applied for the same area (e.g. agri-environment schemes, Natura 2000 compensatory payments etc.).
The base unit of the LPIS is the physical block. It has permanent and on-site easily identifiable borders (e.g. roads, railroads, drains, embankments, forest margins etc.) and is usually under one type of cultivation (e.g. arable land, grassland, plantation, forest etc.). Generally there are more agricultural fields (parcels) within a physical block and its area can be utilised by more than one farmers. Each physical block is divided into eligible and non-eligible areas. Eligible areas are those that are justified for receiving support. The size of this area can be calculated by subtracting the non-eligible areas from the total size of the block. The non-eligible areas are clearly indicated in the maps. Most common examples for non-eligible areas are residential or farm buildings, small groups of trees, drains and wetlands. Farmers can claim support for only those lands that lie on eligible areas (with the exception of the reed management sub-measure of the agri-environment measure).
In case of supports connected to the land size the identified base unit is the agricultural parcel. It means that each farmer has to indicate the agricultural parcels in the rows of the support claim. The agricultural parcel is a contiguous agricultural land on which one producer cultivates one plant species (or variety).
The adequate utilisation of the European Union Funds is thoroughly controlled by the accredited organisation. As for the land-based supports the control is consisted of cross-checks and physical control; the latter can implemented by on-the-spot checks or remote sensing. During the cross-check the data of the

claims are compared to that of relevant databases. In this way parts of the unjustified claims as well as the double/multiple claimed areas and the overclaiming can be filtered out. (Overclaiming occurs when the farmers involved in a certain physical block altogether claim support for larger area than the eligible size of the given physical block.) During remote sensing the actual size of the parcels and their cultivation types are determined. Within the framework of the on-the-spot checks the inspectors complete a report on the results of the check: in case of area-based supports the actual size of the area measured by using GNSS equipment, the cultivated plant species and the level of complying with the rules of the Good Agricultural and Environmental Conditions (GAEC). According to the provisions the cross-checks shall be implemented for 100% of the claims; in case of direct payments at least 5% and at least 1% of the total supported area shall be covered by remote sensing and on-the-spot checks, respectively.
The European Union sets the extent of the sanctions in legislation depending on the degree of discrepancy between the size of the area claimed by the farmer and the actual size of the area cultivated by him/her.
Since the process of the remote sensing control can be affected by multiple faults, a tolerance interval shall be determined. This interval shall be incorporated into the compensation mechanisms as regards of area discrepancies when applying remote sensing control.

2. MATERIALS AND METHODS

During the remote sensing control both the so-called farmer drawings (the outlines of cultivated parcels drawn on the web surface by farmers) and the parcel maps vectorised by using the remote sensing images.
Primarily the following sources of errors called for the establishment of the measurement tolerance interval: 1: the size of the scale of agricultural activities; 2: the inaccuracy during the claiming process (farmer drawings); 3: the inaccuracy of the control data sources and 4: the inaccuracy of the control methods.
The essence of validation of orthoimagery is to calculate more exact tolerance value in an environment similar to that of the parcel assessment. This tolerance value is adequate for both the local circumstances (e.g. terrain and parcel structure) and the sensory (e.g. radiometric or spectral) attributes of the reference images.
The goal of validation of orthoimagery is only to determine the tolerance value (in metres) used in CwRS (Control with Remote Sensing) processes.
Although the parcels selected for the validation provide a representative sample of the given parcel structure, besides VHR (very high resolution imagery) as the primary reference the validation does not take other references, such as a physical block, other claims, other vector layers or local interpretation rules into account.
According to the European Commission Regulation a Member State are required to use "means proven to assure measurement of quality at least equivalent to that required by applicable technical standard, as drawn up at Community level" [5].
The quality of a measurement tool can be characterized by a number of parameters such as its bias, precision and accuracy. Assuming there is no bias, it can also be characterized by its reproducibility limit, which is the parameter used to determine the technical tolerance [6].
The method of calculating tolerance interval for a given parcel (1):

$$[\text{shape.Area } (m^2) - (\mathbf{X} \text{ (m)} * \text{shape.Perimeter (m)}), \text{shape.Area } (m^2) + (\mathbf{X} \text{ (m)} * \text{shape.Perimeter (m)})] \quad (1)$$

where, shape.Area the area of the parcel,
shape.Perimeter the perimeter of the parcel and
X the value of the tolerance and (0,5<=X<=1,5)
Calculating the tolerance value (2) based on the general rule of thumb:

$$X = \text{pixelsize (m)} * 1{,}5 \quad (2)$$

According to the validation protocol 30 parcels (class) are digitalised using 4 repetitions (set) due to the repeatability and reproducibility examinations by 6 operators. Therefore the tolerance value can be determined based on 720 measurement results.

2.1. Set of Parcels

Validation tests can reliably run on a sample consisting of at least 30 parcels.
Each of the images to be validated covers one CwRS control zone, i.e. the selection population is equal to all claimed parcels of a zone. Therefore the 30 parcels are generally selected from among 1,500 to 5,000 parcels. Based on the recommendation of the Joint Reseach Center (JRC) the parcel size [small (0,05 - 1ha), medium (1 - 5ha), large (5 - 10ha)], shape (compact, elongated, very elongated) and the clarity and recognisability of the parcel borders (easy, fuzzy) shall also be taken into account.
The 6 operators interpret the selected parcels using four repetitions, in four separate days and in various order.
Sketches created by a 15 m negative buffer help the orientation regarding the images and the identification of the selected parcels. In this way these sketches do not influence the operator but provide general orientation in case of poorly visible borders.

2.2. Metadata about Orthoimageries

The VHRs selected for the examination are those image references that are characteristic to the two platforms and, considering their parameters, are used the most widespread.

As training fields we have an aerial and a satellite imagery:

	Airborne imagery	*Satellite imagery*
Acquisition date	17th April 2014	25th April 2014
Number of Bands	RGB and CIR	RGB and CIR
Cell size (X; Y) (m)	0,2; 0,2	0,5; 0,5
Pixel Depth (bit)	8	16

2.3. Statistically analysis and tolerance estimation

This measurement accuracy is determined through an area measurement validation test, whose main output is a reproducibility limit at 95% confidence level, expressed as buffer width [7].

The tolerance value estimation was performed according to the JRC guidelines on validation. All measurements were prepared and analysed statistically according to the ISO 5725-2 based method [8].

The foremost applied Cochran's test checks variation of standard deviation between classes. The outlying observations are classified in outliers and stragglers.
Here given a set of p standard deviations S_i, all computed from the same number (n) of replicate results, Cochran's test statistic (3), C, is

$$C = \frac{S_{\max}^2}{\sum_{i=1}^{p} S_i^2} \tag{3}$$

where S_{max} is the highest standard deviation in the set.

Grubbs' test (Nr.1) (4) for single observation checks the variation of observed value in class, where the standard deviation is calculated within a Cochran's test resulted straggler class:

$$G_1 = \frac{\overline{X} - X_1}{S} \tag{4}$$

Grubbs' test (Nr.2) (5) for two outlying observations checks the variation of means between classes, where standard deviation is calculated between classes:

$$G = \frac{\sum_{i=1}^{p-2}(X_i - \overline{X}_{p-1,p})^2}{\sum_{i=1}^{p}(X_i - \overline{X})^2} \tag{5}$$

Following the exclusion of outlier measurement results, sets or classes the determination of tolerance value derived from the average of the tolerance values of the given classes can be commenced by also taking the area and perimeter of the reference parcels into consideration.

2.4. Use of physical block

The goal of the examination is, besides the comparison of the two acquisition platforms and resolutions, to run the validation process based on the new data series created by taking into account the borders of the physical blocks representing a strict limitation in CwRS and a border for the claimed and control parcels as well as to compare the results.

The borders of the physical blocks that have great significance in CwRS are taken also into account here similarly, by cutting the polygons of the parcels, see Fig. 1.

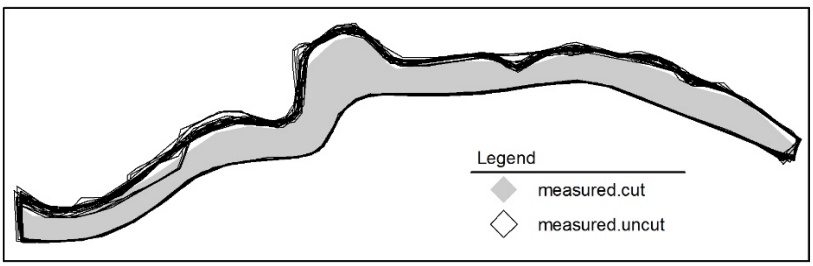

Figure 1. A sample parcel with fuzzy boarder

Fig. 1 illustrates, that the area and the perimeter of the parcel variations shows notable differences and the border of the parcel is not regularly easy or fuzzy on every border unit.

3. RESULTS

Results of the validation process run in both the original (.uncut) and cut (.cut) versions of the measured and reference parcels are summarised in Tab. 1. The X values in the cells represent the calculated tolerance value according to the given combination of the input data types. Data series *measured* includes the 720 validation measurements while *reference* covers the 30 reference parcels.

Table 1. Estimated tolerance values by platform and method

Airborne imagery	reference.uncut	reference.cut
measured.uncut	X_{V1} = 0,9672 m	X_{V3} = 0,9346 m
measured.cut	X_{V2} = 0,4991 m	X_{V4} = 0,4767 m
Satellite imagery	reference.uncut	reference.cut
measured.uncut	X_{V1} = 1,4419 m	X_{V3} = 1,4573 m
measured.cut	X_{V2} = 1,0924 m	X_{V4} = 1,1004 m

The results of the validation process, thus the tolerance values are in line with the previous expectations. By including the borders of the physical blocks, i.e. by cutting the overstretching parcel borders and hence

having homogenising effect within the class the standard deviation decreased and so did the determined tolerance value.
The relatively subjective selection method of the parcels has rather significant influence on the results. Having examined the class results it can be observed that the most remarkable impacts are clearly made by the parcel border types (easy or fuzzy). Therefore the selection of the parcels influences the results in at least as great extent as the applied measurement methods do [9] (Fig. 2).

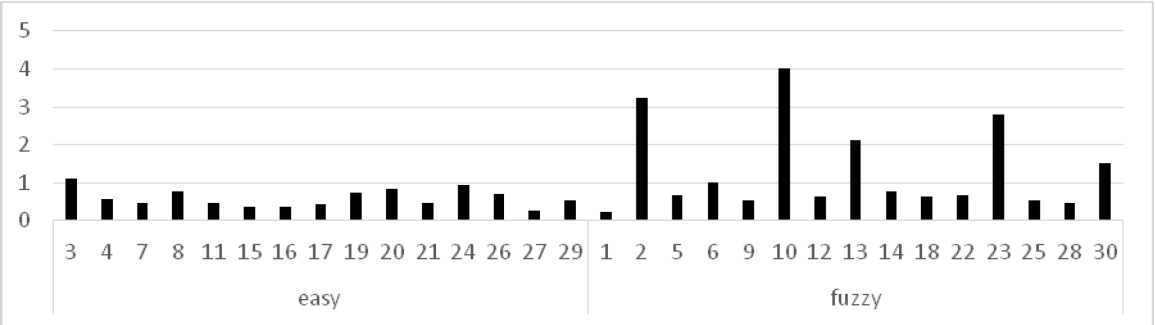

Figure 2. Buffer limit (m) for each parcel of airborne imagery version V1 (reference/measure.uncut), sorted by border type (easy/fuzzy)

4. DISCUSSION

The method ignores the faults originated from the inner distortions of the image that can lead to considerable anomalies during CwRS interpretation. This method could take into account this impact indirectly, by considering the reference parcels. However, it can be seen by the results indicated in the table that combining the same measurement results with different versions of the reference parcels (.uncut/.cut) brings no significant result. Furthermore, the direction of this effect cannot be pre-defined, since it decreased the tolerance value in case of airborne imagery while in case of satellite imagery the tolerance value has been increased [10].

Including the physical blocks in the determination of tolerance value is not recommended due to – among others – its unknown accuracy. As a conclusion of the examination it can be stated that the tolerance value determined by this method and used in countries applying the physical block system can be appropriate for the CwRS interpretation and in some cases can be favourable for those under control.

During measuring the method adequately detects those measurements that considerably deviate from the average within the set and/or class, thus are strongly affected by measurement faults.

5. CONCLUSIONS

There are no direct results on the geometric accuracy of the validated image since the validation process is based on the multiple validation of the same image. This deficiency is intended to avoid by a step in the validation process that takes also the values of the reference parcels into account. Nevertheless, it can be seen by the results interpreted in the scale between 0.5 m and 1.5 m that while cutting the parcels (measured.uncut/.cut) the difference can be as large as 0.4681 m, in case of cutting the references (reference.uncut/.cut) the biggest difference is only 0.0326 m.
The validation process takes account of neither the geometric, nor the orthorectification inner faults and distortions of the image. These faults can emerge during the CwRS process when joint utilisation together with the other raster reference material is implemented.
It can be concluded that this validation method emphasize rather the given parcel structure and interpretation rules than the given image. Therefore this method is rather an estimation of a value as technical tolerance for CwRS and not a validation of a sensor or imagery.
The validation method in its recent form is rather conform to on-the-spot GNSS measurements than to image tolerance calculations.

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POSSIBLE MATERIALS AND PRODUCTION TECHNOLOGIES FOR A SPECIAL PURPOSE HELICAL TORSION SPRING

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ABSTRACT

There are a huge number of ideas at the area of traction drives and also at that of the epicyclic or by other words, planetary drives. The majority of these designs, contain solely rigid wheels, and the contact forces that are proportional to the transmitted torque are produced by separate clamping devices. The author introduced an innovative design, which integrates some elements with merging functions. A part of the contacting rollers are elastic ones and their shape assures the requirement of uniform strength. The curiosities of the elastic rollers are their shapes. Observing both their shapes and loads, they are helical torsion springs. They can be made of pure metals and composites, so of spring steel and also from fiber-reinforced plastics. There is a wide range of production technology considered depending on individual or mass production. The author has received some ideas from the areas of helical spring bearings, the machined torsion springs and the fiber-reinforced tubes. He also find a method to coil helical torsion spring of uniform strength from sheet metal, making the pre-manufactured "wire" of changing width by laser cutting, and to cut tubes by spark cutting.

Keywords: helical torsion spring, sheet metal, tube, laser cutting, spark cutting, fibre-reinforced palstic

1. INTRODUCTION

The epicyclic gear drive is a commonly used drive both for reducing and increasing speed with high efficiency. They are able to transmit power with high power density. The rigidity of the elements of the drive is usually high, but there are applications with elastic elements too. There are applications where some disadvantage should be avoided. These are the relatively high production costs, the large noise in multiplication service, the sensitivity of the drive for the lubrication and the required production accuracy considering the gears and bearings.
There are applications, where some points of views are not so important, as that of the others. When the accurate transmission ratio or the extremely high power density is not required, epicyclic traction drive can be applied. There are many areas where the simplicity, the low noise level and the price are more important. Epicyclic traction drives are used in many fields, including the tinny drives of human prosthesis and the drives of infinitely changing transmission ratios.
One of the problems of traction drives is the efficiency, though the influencing factors can be eliminated.

- Traction fluid enables greater allowable contact stress, without the danger of seizure (scuffing) of the hardened steel surfaces.
- The geometric slip can be also avoided by the proper geometry of the contacting surfaces.
- The traction drives are force closing, so they require tensioning. The tensioning device should produce a compressive force that is proportional to the transmitting load. This device makes the drive more complicated.
- Merging the functions seems to be a proper method for simplifying the design.

An epicyclic traction drive which avoids geometrical slip, can be so efficient as that of the gear drive.
The materials of the basic elements of the drive depend on their function and the necessary power density. The necessity of lubricant is influenced by the amount of dissipated heat. The quality of lubricant (when required any) depends on the types of contacting surfaces. A pair of materials, which tends not to adhesion, and there is no danger for overheating, needs not any lubricant.
The selected type of epicyclic drive that we should analysed is a simple one with single inner and single outer connection and designated as io type drive, is shown in Fig. 1. The usual transmission ratio range is shown in Fig 2.
Our idea is an epicyclic traction drive with elastic elements [5]. Some of the elements are helical torsion springs, as the Fig. 3 shows. The planet wheel, 2 can be rigid and self aligning in relation to the planet carrier. The drive is unidirectional. It means that the drive can transmit power only at one sense of rotation. The springs include both the function of traction wheel and the clamping device. The opposite sense of rotation results a zero output power, so it works in an overrunning clutch service.

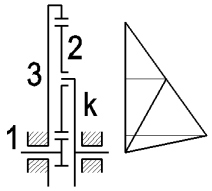

Figure 1. Kinematical model and speed diagram of an io type epicyclic drive

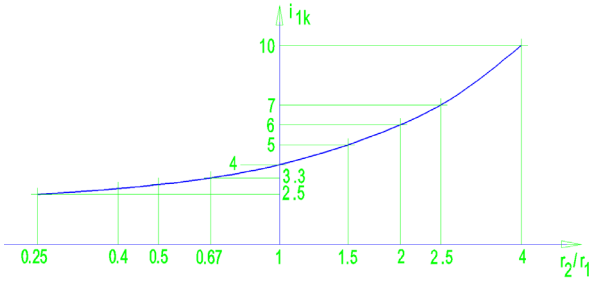

Figure 2. Transmission ratio range of an io type epicyclic drive

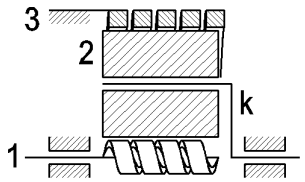

Figure 3. Epicyclic drive with elastic elements

2. THE SHAPE OF THE SPRING

The shape of the spring has got a large variability. The width of strip (and also the lead angle) is constant or changing. On the base of the number of starts, the thread is single or double, and the lead direction along the spring is the same or variable. The most promising shape of springs, both for the sun wheel, 1 and the annular wheel, 3 are shown in Fig. 4 and Fig. 5. Both springs are driven or fixed in the middle of their length. The imagining row material, type of half ready product and type of production method has got a large variability.

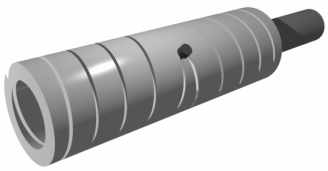

Figure 4. Spatial modes of a single thread spring with changing lead direction and changing strip width

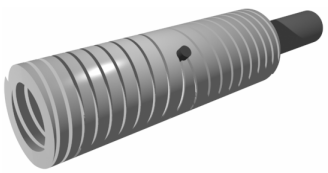

Figure 5. Spatial modes of a double thread spring with changing lead direction and changing strip width

3. MATERIALS

The usual materials for the basic elements of traction drives are the metals or in special cases they are covered by rubber like plastics. The usual spring materials are the metal alloys, the plastics and the composites.
The material and the shape of the spring influence characteristics. A greater output load (torque) requires a greater pressure between the contacting wheels. A spring with linear characteristics facilitates the self adjustment of the clamping force.
On the other hand, the shape of a spring and the material together influence the hysteresis of the springs. A large hysteresis can be useful in special applications, like in the suspension of an aeroplane, where annular springs can absorb the large impact energy of landing. In our problem, at the initial transient phenomenon of the starting process, it seems to be useful to absorb the energy of oscillation.
The shape of the springs is fixed, it is a helical torsion spring. Its load is bending, and the changing width can result a balanced design due to the bending stress.
A natural requirement against the spring material is the high modulus of elasticity. The spring steels can fulfil this constraint, and there are also some other alloys with similar properties. For a power transmission, the great yield strength and the large allowable contact stress are also advantageous. When the materials of the contacting elements are sensitive for adhesion, they should be separated by a suitable machine element that is the lubricant, having proper viscosity and rheopectic behaviour.

4. TECHNOLOGIES FOR PRODUCTION

Nowadays the contacting elements of traction drives are mainly made of steel, especially rolling bearing steel. Sometimes a part of the rollers are standard ball bearing, as it is true for the real particle of the epicyclic traction drive whose kinematical outline is shown by Fig. 6. In this design the planet rollers, 2 are ball bearings. The real cone angle is much less, as it shown. The sun roller and the ring roller is conical, the tensioning force is constant, made by a helical compression spring, through a standard ball bearing.

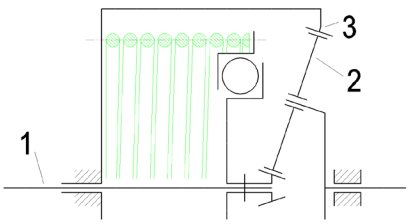

Figure 6. Epicyclic drive with standard planet rollers [7]

Considering the drive in Fig. 3, and the suggested shape of sun and ring rollers, the planet rollers can not be simple ball bearings, but suggested to be made of roller bearing steel. The springs shown in Fig. 4 and Fig. 5 are imagined to be made of spring steel. The pre-product can be sheet metal or tube. Fig. 7 shows the plan of the laser cutting for a double thread helical spring. A winding process should form the final shape of the spring, The diameters should be greater at the sides, to assure an initial tensioning. Modifying the laser cutting plan, an equally stressed shape is obtained, as Fig. 8 shows.

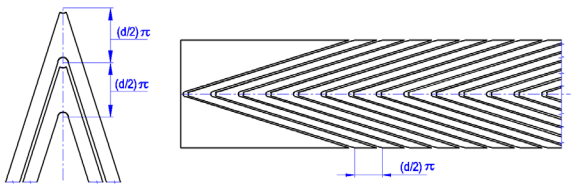

Figure 7. Laser cutting of a sheet metal for a special double thread spring

When the preproduct is hollow cylinder, turning, milling or spark cutting is the possible production technology.
Considering the laser cutting plan of the sheet metal in Fig. 8, the knitting pattern of glass fiber could be the same. Designing the tool for the injection moulding, the mass production of these highly elastic elements would be fulfilled. In this case lubricant is not needed, but the necessity of cooling by air or water should be further investigated.

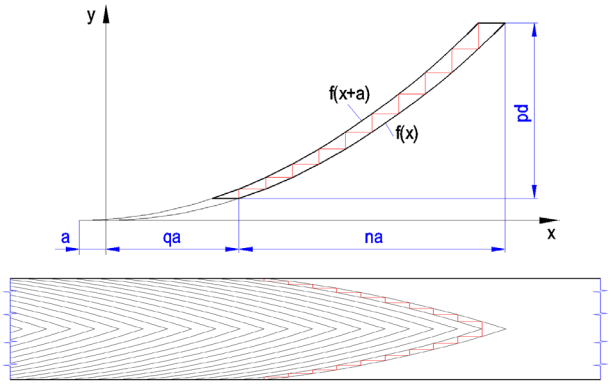

Figure 8. Mathematical formulation of the equally stressed shape – varying ribbon width

The moulding is also a suitable technology for mass production of fibre reinforced plastics parts. Fig. 9 and 10 show the forming of tool and the removal of the ready made part for a single thread spring with changing lead direction and constant strip width.
The core die made of two identical parts, the cavity die made of one piece. After finishing the moulding process the core dies can be driven out like bolts, and the plastic part can be pulled out of the cavity die, due to the elasticity of the workpiece. This part is a spring with smooth and burr-free outer surface and perfectly suitable for a sun gear of a low power epicyclic drive. The tapering of the sun roller (and also that of the annular roller) is useful for initial tensioning of the friction drive.
By similar manner, the tool for the annular wheel of the drive can be designed. The only differences are, the cavity die contains the thread and it is split, but the core dye is undivided. The inner surface of the annular spring is smooth and burr-free.

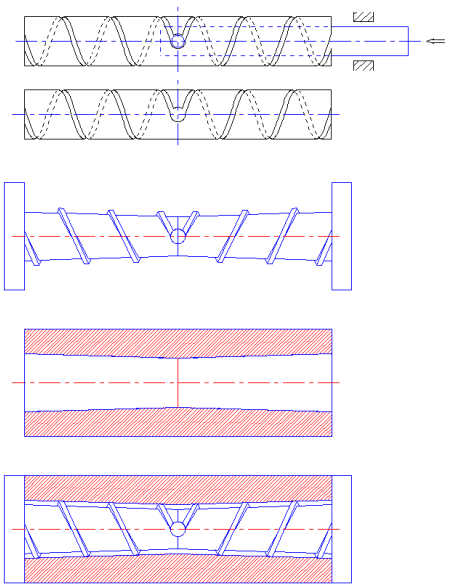

Figure 9. Sun roller and its dies – core dies, cavity die and the tool after assembly

5. CONCLUSION

An epicyclic traction drive with special spring elements was introduced by the author. Using spring steel for the most sensitive sun and ring rollers, the dependency of production technology on the pre-product was also visualized. The author also projected a possible composite material with its technology for the spring elements, naturally for a fully different application with a fully different lubricating and cooling system.

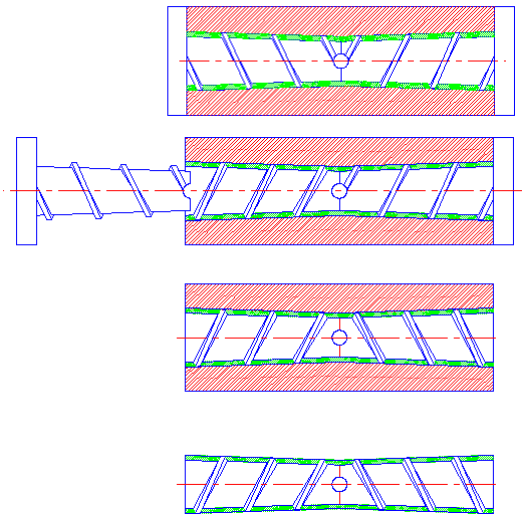

Figure10. The die after moulding and the removal of the ready made part (The inlet is not shown.)

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SHORT INTROSPECTIONS REGARDING THE SAWDUST BRIQUETTING AS SUSTAINABLE SOLUTION FOR THE ENVIRONMENT

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ABSTRACT

Wood pellets have only become an important part of this boom in the past few years. Owners of large coal-fired power stations in Europe started searching for a way to fulfill the new regulations and to find a solution for the declining economic relevance of traditional coal-fired power stations due to their high carbon dioxide emissions. The answer was to give the old dirty giants a green coat of paint by "co-firing" regular coal power plants with wood pellets. Wood pellets have similar burning qualities to traditional coal and the costs of converting boilers to burn wood pellets are low. The idea of declaring wood pellets as a carbon neutral energy source was based on the assumption that the released emissions of carbon dioxide during the burning process are neutralized by the carbon that is captured and stored in newly growing trees. The idea of using wood as a renewable source was backed by environment organizations. More recent pellet investment projects as well as facilities currently under construction show that the production of wood pellets is being outsourced by the energy firms to companies specialized in wood pellet production. These firms are 100-percent focused on sourcing the raw material, operating the wood pellet production plant and handling the logistics for transporting the renewable resource.

Keywords: biomass, wood pellets, briquetting, sawdust, renewable-energy, environment

1. INTRODUCTIVE NOTES

Wood pellets belong to the biomass group of renewable-energies and are gaining in importance to fulfill the European's renewable-energy targets [1, 2 and 10]. The European Commission decided to reduce Europe's greenhouse-gas emissions by 2020 to 20 percent below their 1990 level and to set a goal of moving Europe to 20 percent renewable energy by 2020 [4, 5, 7 and 9]. This decision initiated the boom of renewable-energies in Europe [2, 8 and 9].

Biomass energy production is beneficial to the environment preserving ecosystems and assuring sustainable future. We need to make sure biomass energy is produced in sustainable and ecologically safe way, with little or no pollution to air, water or soil. Biomass is a solution to growing pollution problem and can become a significant energy source in the future, being a sustainable and renewable energy source.

Increasing dependence on a worldwide level of energy resources is that the interest for other energy sources to increase. At the present time, biomass seems to be the most affordable and cost-effective source of renewable energy. Unlike wind energy and solar, investments necessary for the exploitation biomass are best. Modern biomass fuel technology means process the biomass matter with a series of advanced transformation technology into the alternative fuel (solid form, liquid form, gas form), those bio-fuels are used in power generation, vehicle fuel, heating stoves, etc. The solidification formation bio-fuel refers to the biomass briquettes products, the briquette industry started in the 1980s, during the last few years, the briquette industry has been developing very fast: the technologies are much mature nowadays, the production and application have formed a certain scale [6, 8].

According to [10], but generally valuable in the literature, the main advantages of biomass energy production are:

- ✓ Sustainable source – Biomass energy uses organic material and waste for its production. Crops and residues in agriculture and forests are sustainable source of biomass. Managing the resources is important to assure sustainability principles.
- ✓ Renewable source – crops, wood, agricultural residue, can be harvested year after year. Unlike fossil fuel reserves biomass reserves will always be available.
- ✓ Reducing pollution – biomass combustion process emits far less greenhouse gasses into the air than in fossil fuel combustion process. In the process of "gasification" no pollution gasses are emitted into the air.

Also, according to [10], the main disadvantages of biomass energy production are:

- ✓ Resource management – If not managed correctly, forests and land can be used to grow energy crops instead for food production.

- ✓ Direct and indirect CO2 emission – combustion of biomass can contribute to higher carbon concentration in the air.

Biomass refers to substances which occur organically and can be used to generate energy. There are a variety of types of biomass, the most popular being wood. A Biomass system uses the energy generated when burning wood pellets, wood chips or logs in a biomass boiler to generate heat and/or energy. This can be used to power hot water systems, central heating or to heat spaces [10, 11 and 12].

Sawdust is by-product from wood sawing process. Actually, sawdust doesn't have much application because of its low burning efficient. However, by pressing the saw dust into pellets, it becomes a kind of high quality biofuel product – sawdust pellets or wood pellets [8, 10 and 11].

2. TYPE BIOMASS FUELS

More and more cities are seeking solutions in order to produce thermal energy from renewable sources. According to a survey conducted by the Ministry of Environment and the Ministry of Economy, biomass (wood waste, pulses and/or livestock) represents the most affordable and durable resource to produce heat and electricity [3, 7 and 8].

Biomass comes from many different sources [3, 7 and 8]. Most common sources of biomass are:

- ✓ Sustainable forest harvesting and residue,
- ✓ Agricultural residue like wheat straw and energy crops,
- ✓ Animal, municipal and industrial waste.

Figure 1. Biomass sources

Therefore, type biomass fuels include agricultural waste (straw, animals human dung, husks of all kinds – of grapes, walnut, etc.), wood and wood waste (hubs, sawdust, paddles, chips), energy crops (poplar, willow, willow trees, seed and rape) and solid waste in the municipality [8 and 10]. Organic material, such as crops, agricultural and forest residues and waste are easily obtained and available for biopower production. The briquettable materials are: waste wood, bark, old forest, chips and dusts from the wood and paper working, jute fibers and dust, filter dusts from exhaust air and flue gas dust collection of garbage incineration plants, paper scraps from shreddering, hay straw, particle board chips, tobacco dusts, polystyrene, polyurethane foams, cotton stalks, vine cuts, rigid PVC dust, gypsum, spelts, peanut shells, coconut fibers etc.

Wood briquettes

Wood pellets

Figure 2. Solid fuel by woods

In this sense, a lot of companies have as object of activity the recycling and the recovery of wastes or scraps. In these circumstances sawdust will represent raw material for the manufacture solid fuel (briquettes, pellets). It has become more and more important for companies to find low-cost methods of recycling their waste materials. This is especially true if these waste materials have high energy content and we want to take them back into the energy cycle. A number of companies have switched from furnace oil to biomass briquettes to save costs on boiler fuels. The use of biomass briquettes is predominant, where coal and furnace oil are being replaced by biomass briquettes. A number of units are also using biomass briquettes as boiler fuel [10, 11 and 12].

3. THE WOOD – ONE OF THE MOST IMPORTANT RENEWABLE ENERGY SOURCES

With the world population grows and the modernization of the city and towns, one of the city's problems has become more significant every year-the garbage processing. The garbage has two resources: the domestic garbage and the industry waste. The wood processing plants create large quantities of wood residue waste in the daily production, now a large part of the sawdust are used to make compressed wood board for furniture producing and wood briquette for the heating stoves and fireplaces.
Wood is a natural product which – highly compacted as a briquette – almost takes on the burning behavior of coal. Owning to their great density wood briquettes has a higher calorific value than the same quantity of firewood. They can be used instead of coal or wood in domestic solid-fuel stoves as well as in industrial furnaces [10, 11 and 12].
Wood, one of the most important renewable energy sources in its possession Romania, it is not operated. The potential of wood is not used in systems thermal power plants in Romania, due to a lack of technology and legislation. Romania has made many steps humble about capitalization of wood and other wood products and pulp for the production of thermal power in both centralized thermal systems, as well as personal. This fuel is ignored despite environmental and economic advantages.
Specialists in the field say that should be reconsidered potential wood and wood pulp, which can be used as a source of real power. Scientists have pulled signals over two major components, namely reducing energy consumption which polluting the atmosphere, on the one hand, and reducing energy consumption due to quick of the reserves of fossil fuels.
Although Romania has the great advantage to hold an important source of renewable raw material, this is which has not previously been used, and we talking about the bulk of lingo-cellulose's biomass, which enables the development of technologies for recouping and national efficiency, directed at converting thermal energy.

Figure 3. Ligno-cellulose's materials

Recovery of ligno-cellulose's materials by turning them into microbriquettes is not stimulated at national level. A solution would be constitution of a „green" government for the financing of production and exploitation activities or green fuels.
The bill on „circulation" wood should provide and routing lingo-cellulose's materials, with a view to further binding of the unusable components and waste technologies to woody briquette. What's more, it

was launched even put forward the idea of organizing a national structures for the collection, transport and processing of scraps of wood to their conversion into microbriquettes.
In order to obtain a tones of microbriquettes are necessary 1.45 tones of timber, which must be dry. In Romania, with a view to obtaining microbriquettes would be able to use approximately four million cubic meters, which would mean 2.4 million tones of wood. So, on a yearly basis, it would not be approximately 1.65...1.72 million tones of microbriquettes. Specialists appreciate that, in the case microbriquettes obtained from timber, emission of carbon dioxide resulting from ashing is zero. This calculation takes account of the fact that shaft is retained during his life, through the process of photosynthesis, as much carbon dioxide as released by combustion. Quantity pollutant emissions are diminishing, by replacing fossil fuels with wood.

4. BIOMASS HEATING

Biomass is an emerging renewable fuel that can help to heat homes and buildings at lower impact to the environment and lower costs than fossil fuels. The fuel (usually in the form of biomass pellets) is made from sustainable materials, such as wood, which is easily replaced and in abundance, at a relatively cheap price. As people are becoming more and more conscious about their individual impact on the environment and looking into greener, more efficient alternatives, biomass is slowly becoming one of the nation's favorite renewable heat technologies [4 and 8].
Pellet fuels are heating fuels made from compressed biomass. Wood pellets are the most common type. A form of wood fuel, wood pellets are generally made from compacted sawdust or other wastes from sawmilling and other wood products manufacture. Pellets are manufactured in several types and grades as fuels for electric power plants, homes, and other applications in between. Pellets are extremely dense and can be produced with a low moisture content (below 10%) that allows them to be burned with a very high combustion efficiency.

Figure 4. Pellet as heating fuels

Biomass can usually be integrated into a home's existing heating and hot water system and can be an attractive option for households with a reliable wood supply, reasonable storage space and delivery access. Heating a single room using a wood burning stove – or a whole property using a wood-fuelled boiler – is known as biomass heating [10, 11 and 12].
Because the CO_2 absorbed by the trees when they are growing is approximately the same as the CO_2 released when the fuel burns they are considered to be „low carbon". They are not „carbon neutral" or „zero carbon" because there are still carbon emissions associated with the fuel's extraction, processing and transportation.
Some forms of biomass use material grown especially for the purpose, such as field-scale willow. Two are the main types of biomass heating appliances:

- ✓ Stoves: These burn logs or pellets to provide space heating for individual rooms. Stoves can also be fitted with a back boiler to provide hot water for the kitchen and bathroom. Stoves are usually around 7kW and have an efficiency of between 60-80%.
- ✓ Boilers: Larger and more industrial in design, these provide whole house heating and hot water. Domestic log boilers range from 20-50kW and are stoked by hand. Pellet boilers range from 8-30kW and often incorporate a pellet hopper, which automatically feeds the boiler with fuel.

Chip boilers are most efficient for larger (50kW+) systems so are generally not suitable for individual domestic properties. Some biomass boilers are designed to take a variety of wood fuels, including logs, chips and sawdust, and might be viable if you have access to a range of different wood sources.
Wood-burning stoves are still more popular by far, but sales of the relatively new pellet stoves and fireplace inserts are surging. Instead of logs, pellet stoves burn thin rods made mostly from compressed sawdust or wood shavings. Uncertain energy prices have fueled interest in freestanding stoves and fireplace inserts. These outsized space heaters are designed to supplement your central heating system, generally in a large, frequently used room, or perhaps in a central area of the home. Wood-burning stoves are still more popular by far, but sales of pellet stoves and fireplace inserts have surged as consumers look for ways to slice their energy bills.
Three main types of wood fuel can be used: logs, wood chips and wood pellets, according to [1, 2, 3 and 10], but generally valuable in the literature.

- ✓ Logs require little processing except for seasoning (drying out). This process can take up to 3 years and brings their moisture content down to about 20% meaning the logs burn hotter and produce less smoke. Logs are usually cheaper than other types of wood fuel but need more space for storage and can only be used in manual-feed boilers or stoves.
- ✓ Wood chips are sourced from forestry „thinnings" or made from untreated waste wood. Wood chips are typically used in larger heating systems such as those found in schools or blocks of flats. When they are used in smaller (e.g. domestic) systems the chips must be produced to a standard size and with low moisture content.
- ✓ Wood pellets are made from by-products such as saw dust and have a low moisture content of between 8-10%. As a consequence they are more energy-dense than logs or chips and require about a third of the storage space. The uniform shape makes pellets ideal for automated systems.

Figure 5. Main types of wood fuel

Wood fuel is a fuel such as firewood, charcoal, chips, sheets, pellets, and sawdust. The particular form used depends upon factors such as source, quantity, quality and application. In many areas, wood is the most easily available form of fuel, requiring no tools in the case of picking up dead wood, or few tools, although as in any industry, specialized tools, such as skidders and hydraulic wood splitters, have been developed to mechanize production. Sawmill waste and construction industry by-products also include various forms of lumber tailings.
Biomass, the product of recycling, is a man-made renewable resource that contributes to a large portion of recyclable materials. These can include plastics and papers, lumbers, textiles, farming material and fertilizer, to name a few. Because biomass is made from organic products such as animal waste or subsidiaries from agriculture, lumber industries and food industries, biomass has unlimited resources. Recycling and biomass help sustainability throughout the world's industries.
Pellet fuels are heating fuels made from compressed biomass. Wood pellets are the most common type. A form of wood fuel, wood pellets are generally made from compacted sawdust or other wastes from sawmilling and other wood products manufacture. Pellets are manufactured in several types and grades as fuels for electric power plants, homes, and other applications in between. Pellets are extremely dense and can be produced with a low moisture content (below 10%) that allows them to be burned with a very high combustion efficiency.

5. BIOMASS BRIQUETTE EMERGING

A popular biomass briquette emerging in developed countries takes a waste produce such as sawdust, compresses it and then extrudes it to make a reconsistuted log that can replace firewood. It is a similar process to forming a wood pellet but on a larger scale. There are no binders involved in this process. The natural lignin in the wood binds the particles of wood together to form a solid. Burning a wood briquette is far more efficient than burning firewood. Moisture content of a briquette can be as low as 4%, whereas green firewood may be as high as 65%.

The extrusion production technology of briquettes is the process of extrusion screw wastes (straw, sunflower husks, buckwheat, etc.) or finely shredded wood waste (sawdust) under high pressure when heated from 160 to 350°C. The quality of such briquets, especially heat content, is much higher comparing with other methods like using piston presses.

Sawdust briquettes have developed over time with two distinct types: those with holes through the centre, and those that are solid. Both types are classified as briquettes but are formed using different techniques. A solid briquette is manufactured using a piston press that compresses sandwiched layers of sawdust together. Briquettes with a hole are produced with a screw press. The hole is from the screw thread passing through the centre, but it also increases the surface area of the log and aids efficient combustion.

Biomass briquettes are a biofuel substitute to coal and charcoal. Briquettes are mostly used in the developing world, where cooking fuels are not as easily available. There has been a move to the use of briquettes in the developed world, where they are used to heat industrial boilers in order to produce electricity from steam. The briquettes are cofired with coal in order to create the heat supplied to the boiler.

Biomass briquettes, mostly made of green waste and other organic materials, are commonly used for electricity generation, heat and cooking fuel. These compressed compounds contain various organic materials, including rice husk, bagasse, ground nut shells, municipal solid waste and agricultural waste. The composition of the briquettes varies by area due to the availability of raw materials. The raw materials are gathered and compressed into briquette in order to burn longer and make transportation of the goods easier. These briquettes are very different from charcoal because they do not have large concentrations of carbonaceous substances and added materials.

One of the most common variables of the biomass briquette production process is the way the biomass is dried out. Manufacturers can use torrefaction, carbonization, or varying degrees of pyrolysis. Researchers concluded that torrefaction and carbonization are the most efficient forms of drying out biomass, but the use of the briquette determines which method should be used.

The companies promotes the use of sawdust briquettes for heating. It is a totally organic. Solid fuel with low moisture from waste wood left after processing (sawdust, wood chips or bark), wastes are crushed, dried up at a rate of 10% and then plants with a special presses.

Resins and binders existing naturally in the sawdust briquettes are designed to keep them compact and therefore do not contain additives. Using waste wood left after we obtain a valuable product, respecting nature.

Whether we use heat in ovens for pizzerias and bakeries, may use it for central heating and stoves, should we consider a number of factors:

- ✓ A related factor is the environmental aspect. We live where it becomes mandatory, considering that we are responsible for our children's future. Heating by burning briquettes from sawdust ensure no CO2 emissions, protecting the environment. Briquettes are made from sawdust and waste resulting from processing wood in sawmills and furniture. These wastes, unused sawdust are a source of pollution because it does not degrade over time. A very efficient solution for their elimination as a pollutant is briquetting and use as fuel. Also, avoid using sawdust briquettes from forest destruction to get firewood.
- ✓ A second important factor that should we consider when choosing a fuel is its price and efficiency. Based heating cost sawdust briquette is up to 60% less than the price of oil products and at least 40% less than the price of electricity. Lighters of sawdust have a yield much better than wood because of low water content and density of the material. After firing, in case of sawdust briquettes, be very little ash (approximately 1.5%), while in case of using firewood, remains behind the combustion of a proportion of up to 50% ash. Calorific value of briquettes from sawdust is 4800kcal/kg, while the firewood is only 1800-2000 kcal / kg.
- ✓ Another issue is the one related to storage. If firewood, bring it to court, is split and then finely grind and stored. Use sawdust briquettes to eliminate time and money because they just buy and stored in a place away from moisture.

Being an alternative energy, wood pellets play more and more crucial role in human life. And the influence of them now is beyond the field of green energy. The development of wood pellets will bring us great benefits such as social, environmental and economic benefits. The use of renewable energy has several environmental, economic and societal benefits. Renewable energy sources do not require the use of fossil fuels and, as a result, they do not emit carbon dioxide. By reducing the amount of carbon dioxide that goes into the atmosphere, we are eliminating pollution and increasing our air quality.

- ✓ Social Benefits: Slathering wood pellets produces of great assistance to society. Promoting by government authorities all across the globe, wood pellets industry likes great recognition. Not just so, being an emerging industry, wood pellets creating will give you large amounts of jobs, which in certain degree will alleviate the issue of high unemployment, particularly in rural places.
- ✓ Environmental Benefits: In recent centuries, the dominance of non-renewable fuels like coal and oil brought serious atmosphere pollution and green house effect. Wood pellets like a eco-friendly resource can improve this case effectively. In other words, wood pellets could possibly be the definite alternative of fossil fuel and do best to atmosphere.
- ✓ Economic Benefits: Once we have known clearly, wood is really a alternative energy source. Simultaneously, the distribution of wood is wide around the globe: not just wood, but additionally organic materials like leaves, branches, grass, and lots of many other materials can be found. Only whenever you process these to pellets, moisture contained could be reduced to ensure that to vow our prime efficiency of wood.

Biomass carries the highest potential for green energy production in the country, amounting around 88.33 TWh per year. It is estimated that approx. 36% of this potential is currently used, but so far, biomass usage has mainly focused on household firewood: direct burning, space heating, cooking and water heating account for around 95% of the current biomass exploitation, while industrial biomass use equals only 5%. Carpathians and Sub-Carpathians provide around 66% of the firewood and wood waste, whilst the South Plain, West Plain and Moldova regions provide approximately 58% of the agricultural waste. About 27% of Romania's land is covered by forests, whose exploitable potential is estimated at 20,000 cm.

The wood pellets are clean-burning, carbon-neutral, and locally produced—a renewable resource grown in sustainable forests. That's as green as a fuel can get. Heating the home with pellets offers three ecological advantages: pellets are sourced locally; they're a renewable resource; and they're carbon-neutral.

New wood-pellet home heating technologies allow customers to easily upgrade their existing oil-fired furnaces and boilers to wood pellets simply by swapping out the burner. Now you can choose a central heating system that's completely automated and environmentally friendly while you save on home heating bills year after year.

6. CONCLUSIONS

Briquetting is a process that biomass is compressed under high pressure and high temperature. The self bonding of biomass to form a briquette involves the thermo-plastic flow of the biomass. The lignin content that occurs naturally in biomass is liberated under high pressure and temperature. Lignin serves as the glue in the briquetting process, thus binding, compressing the biomass to form into high density briquettes. During this process, no binder needs to be used. So the output briquette is a type of clean and green fuel that is ideal for use in furnaces, boilers and open fires.

In our current economic climate we are all looking to make positive changes to the way we live financially. At the same time the pressing topic of climate change means that we also need to make environmental changes, and heating is one of the priorities.

Using briquettes ourselves we noticed a vast difference in the quality of products being supplied. We noticed more and people opening up old fireplaces and installing wood burners in an effort to reduce their energy bills.

Generally the better quality wood is used in the furniture and construction industries leaving very little good quality timber for firewood production. A lot of the time the cost of producing the firewood on a commercial scale is just too high for most to bother with. We found that later in the season that seasoned wood is unavailable due to high demand resulting in the market being flooded with green timber.

As well as seasoned firewood they also supply sawdust briquettes.

Biomass is a renewable energy source because we can always grow more trees and crops, and waste will always exist. When burned, the chemical energy in biomass is released as heat. If we have a fireplace, the wood burn in it is a biomass fuel. Wood waste can be burned to produce steam for making electricity, or to provide heat to industries and homes.

Biomass, unlike any other resource, is available to us in excess. Its abundance is what makes it a useful asset to mankind, and we can never fear its running out. Everywhere has land available for growing biomass. The process of converting biomass into useful energy is a plain process. If biomass is grown on a large scale, it can save tremendous amount of money in importing oil and rural areas become economically more vital and stable. In addition, biomass can be mixed with coal in coal power plants without making any alterations to the plant. Biomass, if used effectively and efficiently, could be a catalyst in the future of earths' renewable energy system. Moreover, it is cheap compared to its rival resources.

Therefore, biomass is seen as an economically viable and environmentally friendly solution to energy generation. Biomass is a financially viable investment as well as being environmentally friendly. Biofuels provide a unique opportunity to address needs ranging from energy independence to environmental sustainability and economic development, with solutions that include the creation of new opportunities and jobs. These demands have led to government initiatives and accelerated research and development at universities and among leaders in the energy industry.

The different countries clearly have chosen very different approaches in developing and deploying various bio-energy options. Partly this is caused by the natural conditions (type of resources and crops, climate) and the structure of the energy system, and also by the specific political priorities linked to the agricultural and forestry sectors in those countries.

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SIMULTANEOUS SACCHARIFICATION AND FERMENTATION OF TOBACCO SAMPLES

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ABSTRACT

Tobacco plants *(Nicotiana rustica, Nicotiana tabacum)* produce abundant biomass in more than 100 countries and could be used to produce abundant biofuels. Tobacco is an ideal crop for biobased products; it is a perennial herbaceous plant. About one quarter of the tobacco plant is cellulosic material. Tobacco stem is a by-product in the tobacco industry after the tobacco leaves are harvested. The utilization ratio of tobacco stem is only approximately 40% due to difficulties in the comprehensive utilization technologies of tobacco stem. Therefore most of the tobacco stems have gone to waste. This biomass appears attractive for conversion to ethanol because it contains very low amounts of the hard-to-convert woody material lignin. The aim of this study is to identify the best parameters of the simultaneous saccharification and fermentation (SSF) process on tobacco based substrate. Just to make this technology cheaper, the enzyme recovery was investigated by membrane technology. Polyethersulfone membrane filters with 0.1 μm were used for microfiltration followed by determination of proteins using photometer and Kjeldahl method to measure the enzyme recovery. The aim was to decide whether the microfiltration membrane with cut-off 0.1 μm is a proper membrane for recycling the enzyme. During the filtration, increased resistance and decreased flux were detected.

Keywords: tobacco, biofuel, microfiltration

1. INTRODUCTION

With the inevitable depletion of the world's petroleum supply [11], there is an increasing worldwide interest in alternative, non-petroleum-based sources of energy. As petroleum supplies 97% of the energy consumed for transportation [18], industry and governments worldwide have been actively identifying, developing and commercializing technology for alternative transportation fuels over the past 20 years [20, 24]. Due to diminishing fossil fuel reserves, alternative energy sources need to be renewable, sustainable, efficient, cost effective, convenient and safe [5].

Unlike fossil fuels, ethanol is a renewable energy source produced through fermentation of sugars [3,10,24]. Ethanol is an attractive alternative fuel since that it can be blended with gasoline or used as neat alcohol in dedicated engines, taking advantage of the higher octane number and higher heat of vaporization [9]. Currently, Brazil and the United States are the two countries that produce large quantities of fuel ethanol from sugar cane and maize respectively, and they together account for about 70% of the world bioethanol production [4].

Nicotiana spp. is one of the most important nonfood crops that are widely cultivated worldwide [16]. As a raw material, tobacco is used to yield smoked food-tobacco products, which are intended to be smoked, sucked, chewed or snuffed. However, the health risk of tobacco consumption is getting more and more attention by people. For these years, in order to reduce harmful component of cigarette smoking, the biomass material of tobacco stem have been widely applied to cigarette, such as expanded stems [20], reconstituted tobacco sheets [7]. Tobacco stem is a by-product in the tobacco industry after the tobacco leaves are harvested. Unfortunately, the utilization ratio of tobacco stem is only approximately 40% due to difficulties in the comprehensive utilization technologies of tobacco stems. Therefore, most of the tobacco stems have gone to waste. According to an incomplete statistical analysis of 2008, more than 366.2 thousand tons of tobacco stems were disposed of as rubbish worldwide. It led to enormous waste of natural plant resource and serious environmental pollution [12], [13] [24]. Therefore, the reutilization of this industrial waste and the exploitation for potential biomass material would be important and indispensable [19] [21] [25]. Processes based on membranes have been suggested as a good solution for the enzyme recovery because they are energy efficient processes and provide an efficient treatment [8][22].

2. MATERIAL AND METHODS

2.1. Raw material

The hydrolyzate was made from tobacco "Experimental" and "By-products" tobacco samples and they were get from a Hungarian tobacco plant cultivation. The "experimental" (EX) samples were the whole plant, the stem and leaves at all. Meanwhile the "by-product" (BY) consisted mainly on the stem, the part of plant after tobacco-processing. The samples were cut and frozen after harvesting immediately and were keeping in deep frozen until hydrolysis. One part of the samples was cut by cutter to reduce the size of particles before hydrolysis.
Dry matter (DM) was determined by drying the samples overnight at 105 °C.

2.2. Enzymatic saccharification

Saccharification of the samples was carried out in a 2 L fermentation unit (Labfors Minifors, Belgium) at 30°C±0.2 and pH 4.5±0.1 at 160 rpm.
The substrate concentration in the glass flask was 80 g DM/l. The enzyme (endo-1,4-β xylanase from *Trichoderma longibrachiatum;* Sigma Aldrich) and the yeast *(Saccharomyces cerevisiae,* Unikén wine yeast) dose was determined by experimental design that is why it was applied dosed in a different concentration of 4000 or 4800 mg/ enzyme and 1000 or 1500 mg of yeast. The glucose release was monitored after 1, 24, 48, 72 and 96 hours.

2.3. Sugar content

The sugar content was determined spectrophotometrically using 3,5- dinitrosalicylic acid (DNS) method, after calibration. This method tests the presence of free carbonyl group (C=O), called reducing sugars.
It involves the oxidation of the aldehyde functional group present, for example, in glucose and the ketone functional group in fructose. Simultaneously, 3,5-dinitrosalicylic acid (DNS) is reduced to 3-amino, 5-nitrosalicylic acid under alkaline conditions because dissolved oxygen can interfere with glucose oxidation. Sulfite, which itself is not necessary for the color reaction, is added in the reagent to absorb the dissolved oxygen [15].
All samples were diluted 10 times and subsequently 300 µl of DNS were added to 300 µl of samples. The mixtures were heated at 90 °C for 10 minutes to develop the red-brown color. After the heating, 100 µl of potassium sodium tartrate (Rochelle salt) was added in all samples, thereafter the samples were put in a cold water bath and the absorbance was recorded with a spectrophotometer (Nanocolor UV/VIS, Macherey-Nagel) at 540 nm [14,15].
The sugar content was measured at the received ferment-juice and it was given per unit dry material weight basis.

2.4. Centrifuge

The fermented liquid samples were centrifuge at 10 minute and 6500 RPM.

2.5. Ethanol content

Analyses of the ethanol content of the centrifuged fermented liquid was performed at 153°C for 30 minute , in gas chromatograph (DANI Master Restek) with Stabilwax column, which is 30 m long, diameter is 0.25 mm and the film thickness is 0.5 µm. Hydrogen was used as a carrier gas.

2.6. Microfilter equipment

Separation was carried out by a stirred cell device with capacity of 400 cm^3 equipped with a 0.004534 m^2 polyether-sulfone (PES) membrane with a MWCO of 0.1 µm. The sample was mixed continuously with a magnetic stirrer during separation. The relevant data on the membranes are presented in Tab. 1.

Table 1. Characteristics of membranes used

Membrane	Maximum pressure [bar]	MWCO [g mol^{-1}]	Maximum temperature [°C]	Recommended pH Range
PES	0.5-5	0.1 µm	90	2-11

The selectivity of a membrane for a given solute and the efficiency of the process were expressed by the retention (R):

$$R = \left(1 - \frac{c}{c_0}\right) \cdot 100 \quad (\%) \tag{1}$$

Where c is the concentration of the permeate phase (% or mg dm^{-3}), and the c_0 is the concentration of the feed (% or mg dm^{-3}).
The permeate flux (J) can be described as a function of time [6, 8]:

$$J = \frac{dV}{dt} = J_0 t^{-K} \quad (\mathrm{Lm^{-2}h^{-1}}) \tag{2}$$

Where J_0 is the initial permeate flux (L m^{-2} h^{-1}), t is the filtration time (h), and K is the fouling index.
The membrane resistance (R_M) was calculated as:

$$R_M = \frac{\Delta p}{J_w \cdot \eta} \quad (\mathrm{m^{-1}}) \tag{3}$$

Where J_W is the flux of water (m^3 m^{-2} h^{-1}), and η is the water viscosity (Pas).
The fouling resistance (R_f) of the membrane can be measured after washing the gel layer from the membrane. R_f and the resistance of the gel layer (R_g) can be calculated as:

$$R_f = \frac{\Delta p}{J_{WW} \cdot \eta} - R_M \quad (\mathrm{m^{-1}}) \tag{4}$$

$$R_g = R_t - (R_M + R_f) \quad (\mathrm{m^{-1}}) \tag{5}$$

Where J_{WW} is the flux of water (m^3 m^{-2} h^{-1}) after gel layer removal and J_F is the flux of fermented liquid (m^3 m^{-2} h^{-1}).
Reynolds' number in the case of mixing can be calculated via the equation.

$$\mathrm{Re}_{mix} = \frac{d^2 n \rho}{\eta} \quad (-) \tag{6}$$

Where ρ is the density (kg m^{-3}), n is the rotation rate of the stirrer (s^{-1}), η is the viscosity (Pas), and d is the diameter of the stirrer (m).

2.7. Protein content

The protein quantity was determined by the Kjeldhal method. The method consists of three steps: 1) digestion of the sample in sulphuric acid with a catalyst. The nitrogen contained in the sample is converted to ammonia; ammonium sulphate being formed. 2) Distillation of ammonia released from ammonium sulphate by addition of an excess of sodium hydroxide; ammonia being trapped in a trapping solution (sulphuric acid). 3) back-titration of the excess of the trapping solution.

The percentage of crude protein (CP) can be found by multiplying the percent Nitrogen by a factor (usually 6.25).

$$CP = \%N \cdot 6.2 \tag{7}$$

The second method for determination of protein content was spectrophotometrically. The absorbance of samples was measured at 280 nm. The average molar extinction coefficient of proteins is $1.6*10^5$ mol/cm. Distilled water was reset and using the Lambert-Beer law to determine the concentration:

$$A = \varepsilon \cdot c \cdot L \tag{8}$$

Where A is the measured absorbance at 280 nm, ε is the molar extinction coefficient, c is the concentration, L is the pathlenght of the light in cm (in this case the thickness of the cuvette). Molar extinction coefficient (ε) is a measurement of how strongly a chemical species absorbs light at a given wavelength.

3. RESULTS AND DISCUSSION

The aim of the work was to determine optimum parameters of the enzymatic hydrolysis of cellulose to monosaccharides by factorial experimental design. In the first part of this work, a factorial experimental design whit using of excel spreadsheet was prepared. [17].
Tab. 2 shows the experimental data of EX and BY. In the table can be seen that the amount and rate of the xylanase and yeast was changed only at the experiments. One part of the samples were cut by cutter to reduce the size of particles before hydrolysis, therefore the effect of the size reduction was investigated also.

Table 2. Experimental design data of the EX and BY

Samples	H_20 [mL]	Xylanase [mg]	Yeast [mg]	Substrate weight [g]	Measured dry weight [g]	pH	T [ºC]
EX	1000	4000	1000	80	0.586	4.5	30
EX	1000	4800	1500	80	0.586	4.5	30
BY	1000	4000	1000	80	0.513	4.5	30
BY	1000	4800	1500	80	0.513	4.5	30

The Fig. 1-2 and 3-4 demonstrates the effect of the reaction time on the enzyme hydrolysis and ethanol yield at the minced EX and BY tobacco. The results show that the best reaction time for enzymatic hydrolysis of lignocellulose is 24 hours. Optimal enzyme parameters to reach the highest sugar concentration was 4800 mg for the EX samples and 4000 mg for the BY samples.

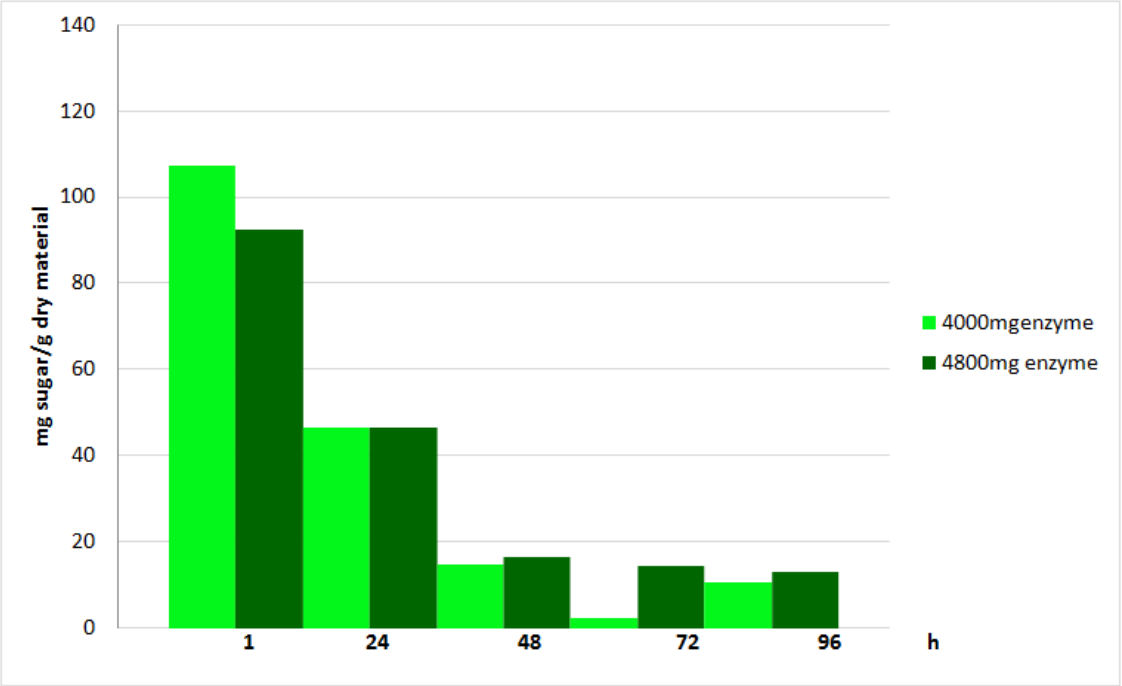

Figure 1. Effect of the reaction time on the enzyme hydrolysis of minced EX tobacco

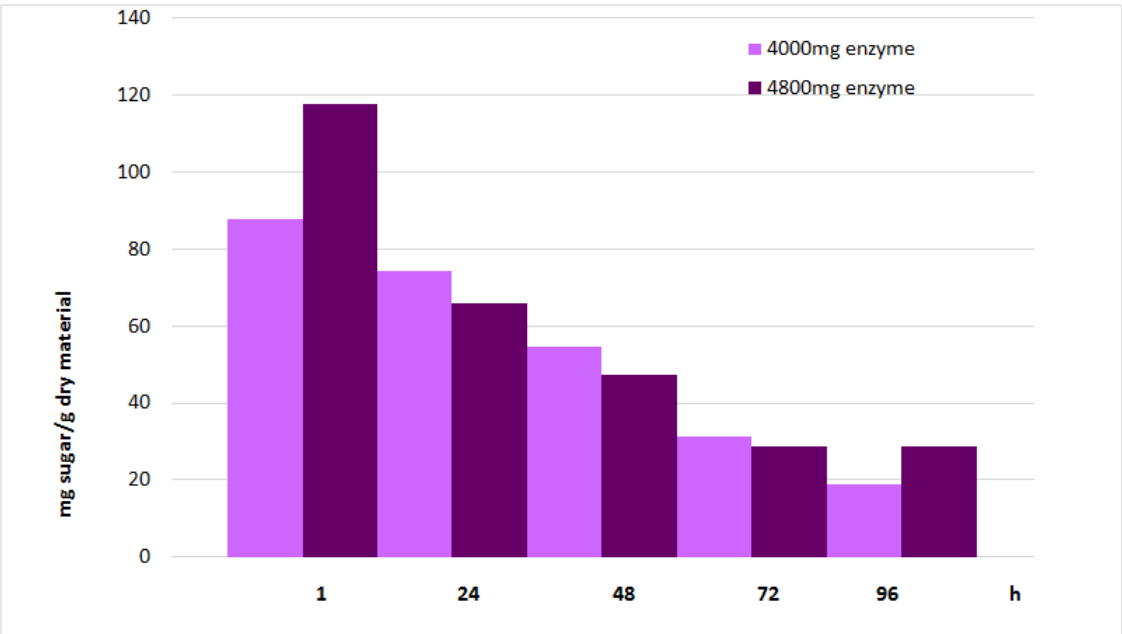

Figure 2. Effect of the reaction time on the enzyme hydrolysis of minced BY tobacco

Ethanol content of each samples were measured on GC after 1; 24; 48; 72 and 96 hours. Fig. 3 and 4.shows the ethanol yield at the By-products (BY) and at the Experimental (EX) tobacco. The optimal time and yeast parameters of the EX samples was 48 hours and 1500 mg yeast and 48 hours 1000 mg yeast at the BY samples. The ethanol concentrations were not so high that is why it will be optimized in the future.

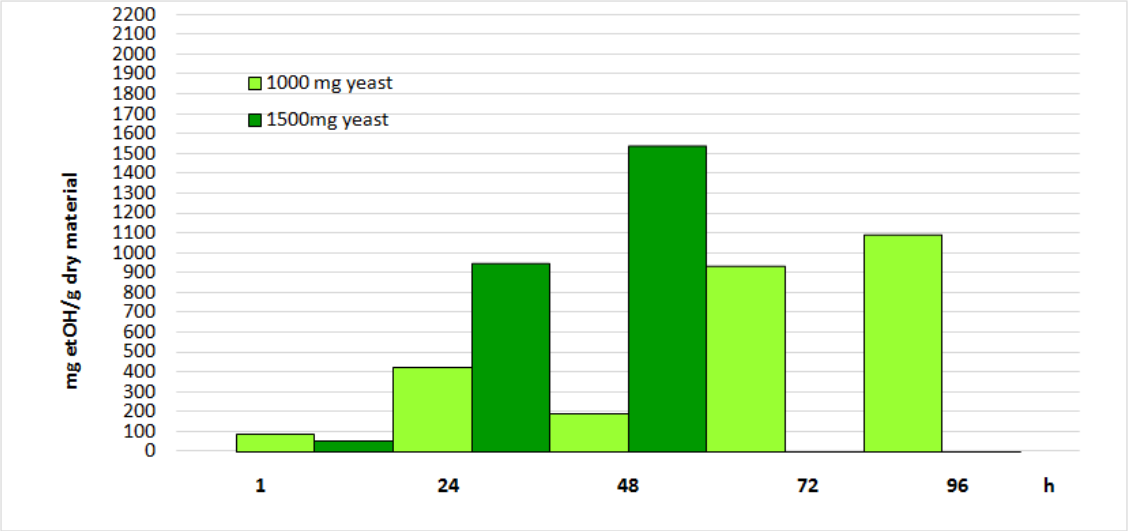

Figure 3. Ethanol yield at Experimental tobacco

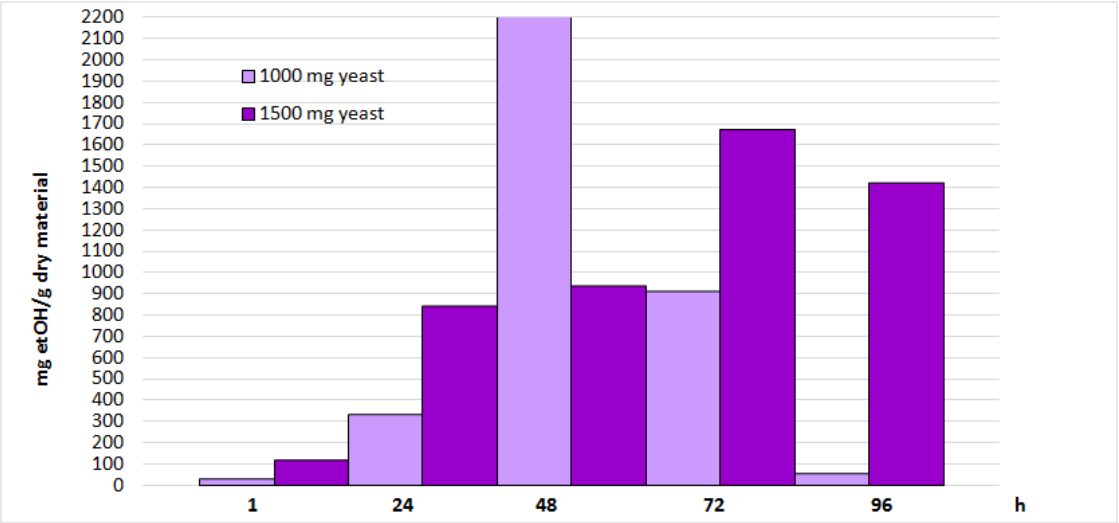

Figure 4. Ethanol yield at By-product tobacco

The second aim of the work was to investigate the possibility of enzyme recovery. For this, the membrane separation was made and the most important separation parameters were determined.
The initial flux of the model solution was the highest due to the composition of the hydrolysate of EX and BY that covered a very wide range of molecules, and the model solution consists only of disaccharides and enzymes (Fig. 5). The flux decline is the highest at the model solution also what is shown by the fouling index values and in the Fig. 6 as well.

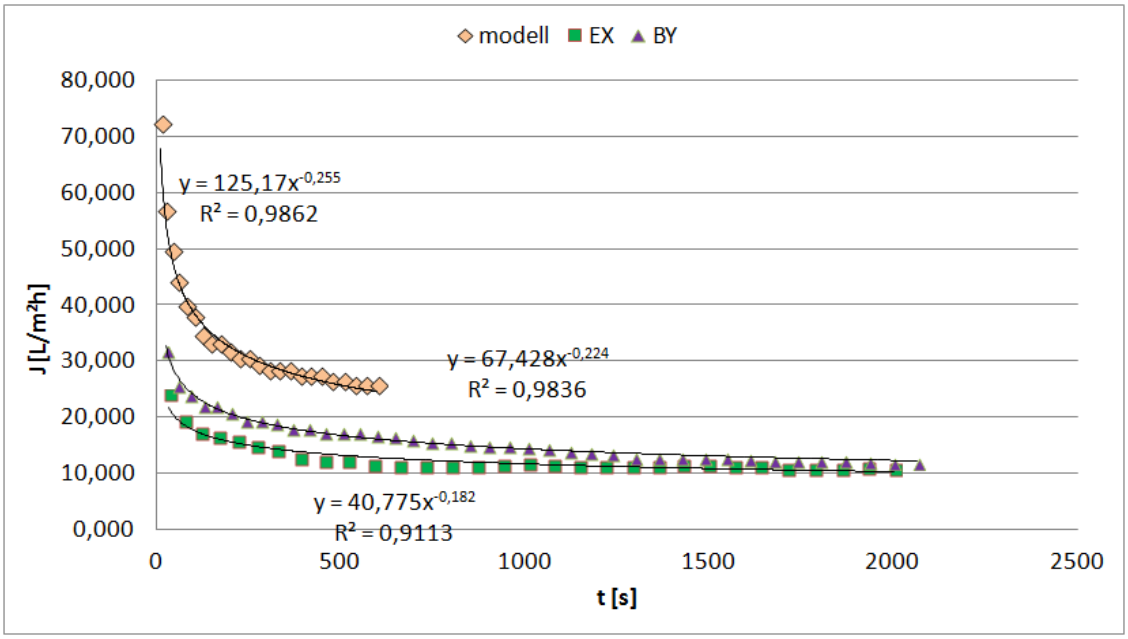

Figure 5. Flux values of the different tobacco samples

There is a significant difference between the curve of model solution and of tobacco hydrolysate samples. The amount of components contained in the hydrolysates makes this difference. There is only a slight difference between the fermented liquid. It shows the difference of the originating, i.e. the BY samples have relative more poorly degradable cellulose fibers than the EX samples.

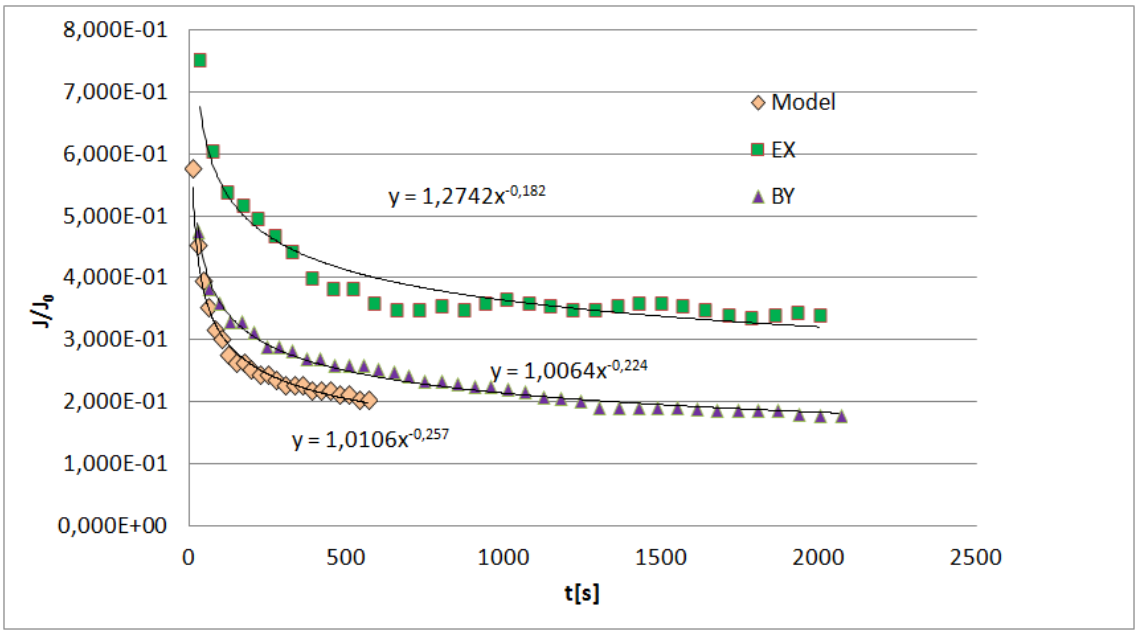

Figure 6. Relative flux values of the different tobacco samples

Three different membrane resistance values were measured and calculated (equations 3-5) during the experiments. First the membrane resistance (Rm), second the resistance of the gel layer on the surface of the membrane (Rg), and finally the fouling resistance (Rf).

Fig. 7 shows that the resistance values were the biggest for the EX samples. Probably it can be concluded that the enzymatic hydrolysate of the cellulose content of EX contains several smaller fragments than the

BY samples. These small particles can penetrate into the membrane pores and increase the fouling resistance. The EX samples contain the whole plant, not only the stem and petiole, so the EX samples have specifically less thick cellulose fibres.

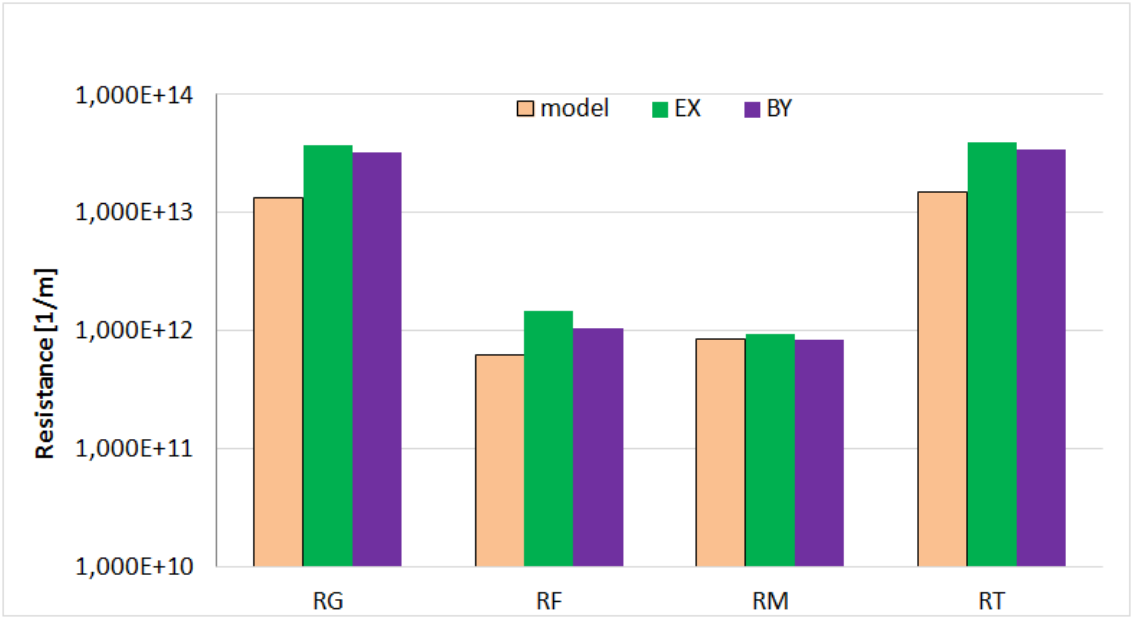

Figure 7. Resistance values of the different tobacco samples

The protein retention values in Fig. 8 shows that the enzymes/ proteins could be separated into the concentrate and also how the 0.1 µm PES membrane retains the proteins/enzymes. Here it can be seen that the value of the proteins in the model solution is the best, but the value of the EX samples is higher than the BY samples, while the composition of the hydrolysate covered a very wide range of molecules, and the model solution consists only of disaccharides and enzymes.

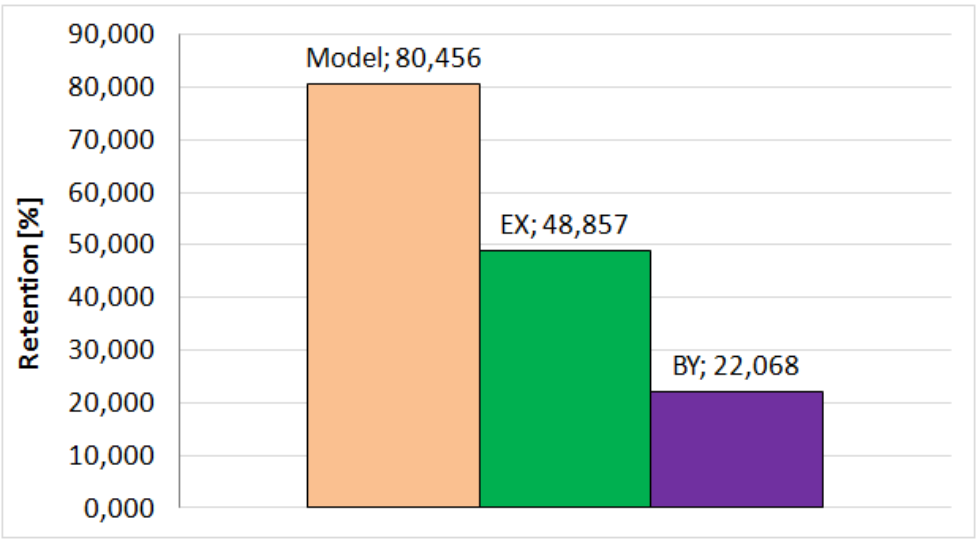

Figure 8. Protein retention values of the different tobacco samples

4. CONCLUSION

In this work the utilization of organic waste from tobacco processing was examined in ethanol production. The main aim of this study was to examine and intensify the enzymatic hydrolysis of cellulose to monosaccharides in order to obtain higher ethanol yield. The bioethanol yield can be large-scale increased by the optimized condition of cellulose hydrolysis prior to the fermentation.
In these experiments the ratio of enzymes to substrate and the reaction time were varied to find the best condition of hydrolysis. The amount of hydrolysed sugar was determined from EX and BY tobacco samples. In both experiments the glucose concentration is high in the samples at 1 hour and 24 hours. The ethanol content of the fermentation broth was determined by gas chromatography. The results showed that the ethanol yield of the EX samples was better at 48 hours with 1500 mg enzyme but at 72 hours and 96 hours with 1000 mg enzyme content samples showed better values. In the case of BY samples there was higher ethanol yield at 48 hours with 1000 mg enzyme and 72; 96 hours with 1500 mg enzyme. Our preliminary results showed that tobacco is a great source of renewable materials that is why it could become a useful biofuel feedstock.
This study shows that the membrane filtration with 0.1 μm cut –off value membrane could help recovering the enzyme, which was used in the fermentation of tobacco samples to create bioethanol. More measurements are needed to check the real enzyme content of the permeate.

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STEPS OF FITTING THE WINTER SHELTER OF HUNGARIAN GREY CATTLE INTO THE ENVIRONMENT IN IPOLYVECE

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ABSTRACT

Besides creating a living place satisfying the unique demands of Hungarian grey cattle the planning of a winter shelter constructed in Ipolyvece (Ipolyvece Farm) has raised exceptionally diverse tasks as regards of fitting the shelter into the environment. This article introduces the different versions of related demands and answers as well as the finally approved solutions which have been created by using – due to necessity – the „research by planning" methodology.
The facility has been constructed for the winter housing of those cattle and their offsprings that live in and around the municipal area of Ipolyvece, i.e. in the alluvial pastures of the Ipoly river during the growing season (from April until the end of October).
The area involved in the planning process includes some plots and buildings of an animal husbandry facility built in the early 1960s. These real estates have been detached from the other parts of the farm and given to the current operator as a result of the privatisation process of the early 1990s.
The installations are situated in the mild North-western slope of Börzsöny mountains. This slope is bounded by a railroad embankment running around the built-up area of the settlement. The embankment is perpendicular to the slope thus creating a valley where the runoff of water is not ensured. A particularly sensitive groundwater supply can be found below the area; this fact makes special protective measures necessary in order to restrain the utilisation and environmental impact of the surface area.

Keywords: animal keeping facility reconstruction, protection of groundwater supply, loose housing for Hungarian grey cattle, settlement planning

1. INTRODUCTION

During the facility development planning process regarding the Ipolyvece Farm [1] the main objective has been to satisfy the keeping demands of the 150 cows and their offsprings to be housed in the facility while taking into consideration the provisions regarding the utilisation of investment resources approved by a tendering process and used in a public procurement procedure. The tasks of „fitting into the environment" were the following:

- satisfying the demands related to the conflict free adjustment to natural attributes (terrain and soils, protection requirements of surface and underground water supplies)
- „selective adjustment" to the systems of the existing artificial environment (land division, access roads, existing public utilities and buildings)

The interactive research and planning process introduced in this article is an example of how budget appropriations, legislative provisions, functional needs, environmental attributes and the decisions of planners and researchers connect to each other, how they propose questions and provide fundaments for decisions.

2. EXAMINATIONS AND METHODS, PLANNING CONSIDERATIONS

2.1. The conflict to be solved

During the planning process the result of the first professional/administrative negotiation has brought up the need of a complex adjustment to the naturally existing features. The Middle-Danube-Valley Inspectorate for Environmental Protection, Nature Conservation and Water Management has included the following stipulation in the minute [2] of the meeting held in connection with the first draft plans completed in the subject: „Based on KVVM decree 27/2004 (XII.25.) the area of Ipolyvece falls under the particularly sensitive category as regards of groundwater protection. (According to the 1:100,000 scale map of the Environmental Protection And Water Management Research Institute displaying the groundwater protection areas this site falls under category 2a: area with a recharge of more than 20 mm.) Based on the provisions of Governmental decree 219/2004 (VII.21.) on the protection of groundwaters animal keeping activities shall only be pursued alongside with *engineered protection*."

This remark has meant that the enclosures of the animals (approximately 1.5 hectare with an average gradient of 5 to 10%) shall be made of concrete so that no manure-contaminated water could drain into the soil.
On the one hand, this solution would have significantly raised the expenditures compared to the planned budget. On the other hand, it would have created a completely inadequate and useless environment for the animals.

2.2. The first proposed solution for eliminating the conflict

The farm development plan of the property developer Danube-Ipoly National Park Directorate is subjected to a preliminary examination due to the fact that the area involved in the planning falls under the particularly sensitive area from the aspect of water protection. [3]
In order to complete the preliminary environmental examination an environmental geology examination was carried out. This examination provides the basis for those planning decisions that are covered by the preliminary environmental examination. [4]
According to the agreement made between the planners and the investor based on the results of the environmental geology examination [4] it shall be assess how and in which extent can the partial cover created on the surface of the enclosures (concrete manure collecting surface, closed manure storage facility) decrease the manure load regarding the uncovered parts of the enclosures. The elements of the planned version are the following:

- The animals are feed in a covered (by concrete) feeding surface and the connected and covered manure path. In this case the manure (based on animal keeping experience and planners' estimation approx. 50% of the total amount of manure) can be collected daily. An adequate capacity (150 days) closed manure storage facility shall be built together with the connected monitoring system to store the collected manure. The calculated amount of manure is 1,300 m^3 which could be stored in a 600 m^2 closed storage facility with retaining walls.
- The other 50% of the animal manure is created either in the clay floor, deep litter resting stables or in the litter-covered resting mounds established within the pens. This amount is to be transported directly to the arable land at the end of the overwintering (150 days) as either littered farmyard manure or pen soil.
- The leachate that is created and run off occasionally (in case of exceptionally heavy rains) in the area of the pens shall be collected in a covered surface reservoir established in the Northern side of the pens (facing the railroad).

The results of the environmental geology examination were sufficient to determine the amount of leachate created and run off occasionally (in case of exceptionally heavy rains) in the area of the pens, as follows:

- The 10 minutes standard rainwater for 4 years frequency is 273.61 l/s/ha
- Infiltration conditions: the infiltration coefficient of the surface fine sand layers is in the order of magnitude of 10^{-4} m/s, thus they are considered as relatively good water draining media. As a consequence, significant amount of the precipitation infiltrates into the soil. The estimated runoff coefficient is 0.15; since the animals are kept in this area in the winter season, a minimal, 5% evaporation is calculated. Therefore approximately 80% of the precipitation infiltrates into the soil.

Calculating the actual amount of leachate:
The final dimensions of the involved enclosures are the following:

- Enclosure for cows: 1.26 ha
- Enclosure for young animals: 0.25 ha

The corrected value of the calculated maximal precipitation:

$$1.51\text{ha} \times 600\text{sec} \times 273.6\text{l/sec/ha} = 247{,}881.60\text{ liter} = 247.9\ \text{m}^3 / 10\text{ minutes} \quad (1)$$

The estimated runoff coefficient: 0.15
The actual amount of leachate:

$$247.9 \times 0.15 = 37.18\ \text{m}^3 / 10\text{ minutes} \quad (2)$$

The closed rainwater basin established at the lower end of the enclosures shall be able to contain at least this amount of water.

2.3. Expected impacts on the groundwater

Calculations of the environmental geology examination [5] related to the impacts on the groundwater [6] have yielded a surprising result:

- *no significant impacts on the body of the underground water can be expected following the modernisation.*

The calculations and factors taken into consideration are the following:

- During operation the load of the underground body of water is derived from those components of manure created in the pens – primarily different forms of N, such as nitrite, nitrate and ammonium – that are soluble by the precipitation.
- Approximately 2,100 t litter manure is generated by the planned size of livestock (based on the planners' data provision; in the calculations this amount is distributed on the uncovered surface of the enclosures); its average N content is 0.5%. According to the literature around 25% of the organic manure nutrients is exposed in the first year; thus, regarding the 1.5 ha total area of the enclosures the maximal annual N load in this area is 3,000 kg (since the 25% exposure is related to a whole year). This amount corresponds to approx. 8,100 kg nitrate.
- Provided that the total amount of released N content reaches the groundwater its nitrate concentration increases by an average of 2.6 mg/l. Based on the results of the baseline survey this load does not impose significant changes in the attributes of the groundwater. [7]

Several of those circumstances were not considered during the calculations that mitigate the impact:

- Certain proportion of the precipitation and slurry is absorbed by the litter.
- Part of the N-based nutrients are utilised (thus absorbed) by the fertile soil organisms and vegetation.
- The fine-grained fraction of surface layers absorbs some of the contamination content of the infiltrating water.
- The extent of infiltration can decrease due to the soil compaction caused by colmatation.
- 25% was calculated for the exposition of organic manure that is a value determined for an entire year while the manure stays in the area no longer than half a year.

2.4. The programme of the concluded plan elaborated in accordance with the results of the environmental geology examination

The fact that no significant contamination of the groundwater can be expected based on the calculations assuming that the whole amount of manure is created on the uncovered surface of the enclosures provided the basis of the following planner-investor decision: in the version described in 2.2 both the concrete-floored manure collection surface and the closed manure storage facility are unnecessary, cost-increasing items.

Moreover, the provision of Governmental decree 219/2004 (VII.21.) on the protection of groundwaters – i.e. animal keeping activities shall only be pursued alongside with *engineered protection* – cannot be maintained; the planned livestock can be kept in uncovered enclosures.

Measures to be taken during the operation of the facility in order to mitigate the impact on the surface and underground water:

- Litter manure shall be removed from the enclosures following the spring driving out so that the leaching of the nutrients would be stopped as soon as possible.
- During winter the rainwater slightly contaminated by manure shall be collected in a covered ditch or basin established in the deepest point of the area. This water can be placed into arable land. In summer when there are neither animals nor litter manure in the area the collected water can be used for the irrigation of the pens.
- In the summer period such plants shall be cultivated in the area of the pens that grows intensively, thus utilising lots of the nutrients leached and accumulated in the upper soil layers. The load of groundwater is decreased this way. These plants can also be utilised as fodder.
- The establishment of an observation well is justified in order to monitor the groundwater quality. By its regular – annual – assessment the changes in the underground body of water can be tracked.

Suggested sampling period: once a year. Components to be examined: general water chemistry. The sampling and the laboratory examination is completed by the involvement of accredited organisations. The suggested location of the observation well is indicated in the detailed site layout.

3. EVALUATION OF RESULTS, CONCLUSIONS

The spatial plan of Ipolyvece and – as a part of it – the local building regulations have been approved in 2009, i.e. 4 or 5 years later than the Governmental decrees ordaining the increased level protection of the area had entered into force. Nevertheless, there is no clue in the local building regulations about the particularly sensitive classification of the area involved by the planning, although this fact determines the utilisation possibilities of the area. Neither the local government nor the users of the land knew that the area falls under the particularly sensitive category as regards of water protection. This is an obvious planning fault. Act XXVI of 2003 on the National Spatial Plan and its Annex 3/7 map indicate clearly the area around Ipolyvece, but the map titled „zones of particularly sensitive groundwaters regarding water protection" in Annex 3/2 of the Nógrád County Spatial Plan elaborated by VÁTI in 2005 does not include this site, although it is included in the table of KVVM decree 7/2005 (III.1.) referenced as the source. This can be (one of) the reason why the obligation of protecting the groundwaters is excluded from among the relevant aspects in the local spatial plan.
Nevertheless, the contradictory final conclusion regarding (1) the delineation and classification made by the 1:100000 scale area database and (2) the results of the on-site examinations calls the attention to the clearly expressed need for conducting environmental geology and environmental protection preliminary examinations during the preparation phase of actual investments. Based on our anticipatory estimations the concrete cover of the 1.5 ha enclosure area would have cost approximately 80 million HUF (as a net amount), besides it would have caused serious damage by hindering and deteriorating the nature-like circumstances of keeping Hungarian grey cattle. The costs of preliminary examinations and that of elaborating the different plan versions related to the establishment of enclosures have consumed only around 1% of the above-mentioned amount.

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THE CONTRIBUTION MODELLING GASOLINE INJECTION AT ENGINES WITH SPARK LIGHTING

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ABSTRACT

The authors present the general aspects of theoretical modeling of gasoline injection, the principle modeling of some of the elements of gasoline injection, namely the gasoline pump model and the pressure regulator model. It is presented the general model of a spark engine with gasoline injection. The modeling of the motor cycles with spark engines and gasoline injection suggested by the authors is realized by executing a computer program for determining the variation of the three-dimensional and bi-dimensional parameters with the sub-programs: program for calculating the SIE (dependence according to n and λ at t_o=-35...+45ºC and $p_o=1\cdot10^2$ kPa); program for calculating the SIE (dependence according to n and t_o at λ=1 and $p_o=1\cdot10^2$ kPa);program for calculating the SIE cycle with gasoline injection. It was realized a study for calculating the pressure from the admission gallery $\mathbf{p_{ga}}$ and the admission pressure $\mathbf{p_a}$.

Keywords: pressure regulator, valve, pulverization, duration of injection.

1. INTRODUCTION: GENERAL ASPECTS OF THE MODELLING

The theoretical and experimental research of the elements and injection systems of gasoline, represent the fundamental components of the analysis and synthesis for knowing the static and dynamic quality performances. The experimental analysis takes place mainly when the system in known, while the theoretic one when we design the system. The usage of computer in modeling the systems considerably enlarges the possibility for studying a of a great number of models in a short period of time, and then through simulation we can follow the answer when applying different entering signals [1].
In the analysis and the synthesis in dynamic running of the injection systems for gasoline we usually use a series of laws, theorems, fluid mechanic and mathematics.

About the mathematical means, we can say that in the majority of the cases the differential equations systems which describe the phenomena which take place inside the injection systems of the gasoline are non-linear.
There is no universally applicable methodology for solving these non-linear equations, so we solve them through approximation, which allow the description of the phenomena to the prejudice of the quality of the simulation.
Among the most frequently used methods we can mention:
Linearization of calculating relation around a functioning stationary point; linear analysis on parts; analysis in the plan of phases; Analysis with description function.
In order to illustrate the linearization method we will present Taylor's formula for a function with two variables. With the help of this formula we can linearize any of the functions around a point [7].
Being given a function f(x,y), which in the neighborhood of (a,b) has continuous partial derivates of (n+1) order, according to Taylor's formula, can be written:

$$f(x,y) = f(ab) + \frac{1}{1!}\left[f'_x(a,b)\cdot(x-a) + f'_y(a,b)(y-b)\right] + \frac{1}{2!}[f''_{xx}(a,b)(x-a)^2(y-b) + 2f''_{xy}(a,b)(x-a)(y-b) +$$

$$+ f''_{yy}(a,b)(y-b)^2] + ... + \frac{1}{n!}\left[(x-a)\frac{\partial}{\partial x} + (y-b)\frac{\partial}{\partial y}\right]^n f(a,b) + R_n(x,y); \quad (1)$$

$$\text{where : } R_n(x,y) = \frac{1}{(n+1)!}\left[(x-a)\frac{\partial}{\partial x} + (y-b)\frac{\partial}{\partial y}\right]^{n+1}\cdot f\left[a+\theta(x-a), b+\theta(y-b)\right], O \prec \theta \prec 1$$

Where: in the particular case a=b=0: we obtain Mac Laurin's formula. Structurally, a system of gasoline injection from an engine represents a succession of energy conversions C1,C2,….,C5, Fig. 1. In the figure the blocks represent, in order: the electric motor drive EMD, the gasoline pump PB, control and adjustment

equipment ARC, (directional equipment for flow regulation and pressure storage, filtering, injection), usually named the organs of the spark ignition engine ESL.
The electric engine is accumulator driven. It transforms the electric energy into mechanic energy, so here takes place the first conversion C1, and then the gasoline pump transforms the mechanic energy into pressure potential energy, in this way the second conversion takes place C2. The electromagnetic injector pulverizes and doses the gasoline in front of the admission valve realizing in this way the conversion of the pressure potential energy and electromagnetic energy into mechanic energy for moving the needle/indicator of the C3 injector. In the combustion chamber of the engine takes place a double energy conversion. When the fuel mixture burns the chemical energy of the fuel is conversed into thermal energy C4, which is transformed into effective work (mechanic energy) and the C5 conversion takes place.
Compared with other systems in a classical acceptation having an entering amount x_i and an outgoing amount x_e, Fig. 1. The system of gasoline injection is presented in systemic acceptation, like a multivariable system in which the component elements (blocks 1….n) are quadric-poles or sexa-poles, and the connection lines (poles) represent the information support of the variables, Fig. 2.
The global driving system supposes the existence of an electric amount (U-voltage, I-intensity), mechanic (n_1- the pump's number of rotations); n (v)- number of rotations of the ESL; M1 – the moment of the pump; M(F)- the moment of the ESL, and hydraulics (Q_p- the pump's flow rate; Q_M the air flow rate at the ESL; pp- pressure of the pump; pM- the pressure at the MAS) ordered in such a way according to the way of transmission of the energy or information. The amounts U, n_1, Q_p, Q_M, and n(v) are called direct variables or movement variables, through which the frequency characteristic of the system is made, while M(F); p_M; p_p; M_1; I – are called effort variables, which supposes the power supply of the system for creating the force or the necessary moment for surmounting of resistant moments or forces from the engine. X and F' are exterior amounts for command. From the global system presented in Fig. 1 we can distinguish the system made by the 2,3,4, blocks, which are in fact the injection system of the gasoline, having the mechanic connections at entrance n1 and M_1; and n(v) and M(F) with four energy conversions at the exit. This subsystem is analyzed on each of its components.

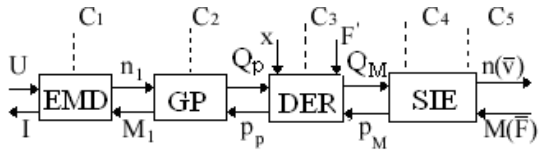

Figure 1. The scheme of the energy conversions for an injection system

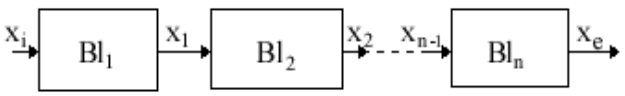

Figure 2. The multi variable system for gasoline injection

2. THE PRESSURE CALCULUS FROM THE ADMISSION GALLERY P_{GA} AND THE ADMISSION PRESSURE P_A

Taking into consideration the admission process on a short length of time, applied the equation of Bernoulli to the gas flow, written for the entering section in the admission system 0 – 0 and a section 1 – 1 (Fig. 3) [5].

We write the equation of Bernoulli between the sections 0 – 0 and 1 – 1

$$\frac{p_o}{\rho} = \frac{p_{ga}}{\rho} + (1+\xi_{ga})\cdot\frac{W_{ga}{}^2}{2}; \quad W_{aer} = 0. \tag{2}$$

It results:

$$p_{ga} = p_o - (1+\xi_{ga})\frac{\rho}{2}\cdot W_{ga}{}^2 = p_o - 1(1+\xi_{ga})\frac{\rho_{aer}}{2}\cdot W_{ga}{}^2 \tag{3}$$

Where:
$\rho_o = \rho_{air}$ is the density of the air (considered constant); $\rho = \gamma/g$; p_o – the from the entering section in the system; p_{ga} - pressure from the admission gallery; W_{ga} – the air flow speed through the admission gallery; ξ_{ga}–the coefficient of gas dynamic resistance of the admission gallery.

Applying the equation of continuity between the 1 – 1 and 2 – 2 sections it results:
$W_{ga} \cdot A_s = W_a \cdot A_c$; $A_s = \pi d_o^2/4$; $V_s = A_c \cdot S \Rightarrow A_c = \frac{V_s}{S}$;
S - the stroke of the piston [m];

$$W_a = W_{pm} = \frac{1}{30} \cdot S \cdot n;\ W_{ga} = W_a \frac{A_c}{A_s} = \frac{1}{30} \cdot S \cdot n \cdot \frac{V_s}{S} \cdot \frac{1}{\frac{\pi d_o^2}{4}}; \tag{4}$$

$$W_{ga} = \frac{4}{30 \cdot \pi} \cdot n \cdot \frac{V_s}{d_o^2};\ p_{ga} = p_o - \left(1 + \xi_{ga}\right) \cdot \frac{\rho_{aer}}{2} \cdot \left(\frac{4}{30\pi}\right)^2 \cdot n^2 \cdot \left(\frac{V_s}{d_o^2}\right)^2; \tag{5}$$

A) The case when the density of the engine fluid ρ is constant

$$p_{ga} = p_o - k_1\left(1 + \xi_{ga}\right) \cdot n^2 \cdot \left(\frac{V_s}{d_o^2}\right)^2; \tag{6}$$

Where: $k_1 = \frac{\rho_{aer}}{2} \cdot \left(\frac{4}{30\pi}\right)^2$

In which: A_s – the area of the free section near the valve; V_s – unitary capacity; S – the stroke of piston; A_c – the area of transversal section of the cylinders; W_a - the air speed in the cylinder; W_{pm} – medium speed of the piston; d_o– diameter of the admission gallery; n – the number of rotations of the crank shaft;
We write the equation of Bernoulli between the sections 1 – 1 and 2 – 2 [4]:

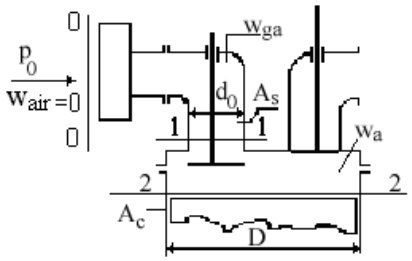

Figure 3. The scheme for analytic calculus of al p_{ga} and p_a

$$\frac{p_{ga}}{\gamma} + \frac{W_{ga}^2}{2g} = \frac{p_a}{\gamma} + \left(1 + \xi_a\right)\frac{W_a^2}{2g}; \tag{7}$$

$$p_a = p_{ga} + \frac{\gamma}{2g} W_{ga}^2 - (1 + \xi_a)\frac{\gamma}{2g} W_a^2 \tag{8}$$

Where: $\xi_a = c_a$ – the coefficient of gas dynamic resistance of the admission way:

$$W_{ga} = \frac{4}{30\pi} \cdot n \cdot \frac{V_s}{d_o^2};\ W_a = \frac{S \cdot n}{30};\ S = \frac{V_s}{A_c} = \frac{V_s}{\frac{\pi D^2}{4}} = \frac{4V_s}{\pi D^2};\ W_a = \frac{4}{30\pi} \cdot n \cdot \frac{V_s}{D^2}; \tag{9}$$

$$p_a = p_{ga} + \frac{\rho_{aer}}{2}\cdot\left(\frac{4}{30\pi}\right)^2\cdot n^2\cdot\left(\frac{V_s}{d_o^2}\right)^2 - (1+\xi_a)\frac{\rho_{aer}}{2}\left(\frac{4}{30\pi}\right)^2\cdot n^2\cdot\left(\frac{V_s}{D^2}\right)^2;$$
$$p_a = p_{ga} - k_1\cdot n^2\cdot V_s^2\left[(1+\xi_a)\frac{1}{D^4} - \frac{1}{d_o^4}\right]. \quad (10)$$

It results, the expression of the admission pressure:

$$p_a = p_{ga} - k_1\cdot n^2\cdot\frac{V_s^2}{d_0^4}\left[(1+\xi_a)\left(\frac{d_o}{D}\right)^4 - 1\right];$$
$$\text{if: } \left[(1+\xi_a)\left(\frac{d_o}{D}\right)^4 - 1\right] > 0;\ (1+\xi_a)\left(\frac{d_o}{D}\right)^4 > 1;\ \Rightarrow \xi_a > \frac{1}{\left(\frac{d_o}{D}\right)^4} - 1. \quad (11)$$

For the Dacia Logan vehicle the ratio $\frac{d_o}{D} = 0{,}42$; ξ_a - the coefficient of gas dynamic resistance of the admission way;

$\xi_a > \frac{1}{0{,}42^4} - 1; \xi_a > 32.$ [7]

By using gasoline injection, the gas dynamic resistence of the admission way is smaller than at the classical engines, where the carburetor and its diffuser introduce a gaso dynamic resistance 8-10 times greater.

B) The case when the density of engine fluid ρ is variable [3].
Bernoulli's relation between the section 0 – 0 and 2 – 2 in this case becomes:

$$p_o = p_a + (1+\xi a)\frac{\rho_a}{2}\cdot W_a{}^2;\ \rho_a = \frac{p_a}{RT_a};$$
$$W_a = W_p = \frac{n}{30}S = \frac{n}{30}\frac{V_s}{Ac} = \frac{4}{30\pi}\cdot\frac{V_s}{D^2}\cdot n; \quad (12)$$

$$a_{sa} = \sqrt{k_a\cdot RT_a} \Rightarrow RT_a = \frac{a_{sa}^2}{k_a};\ \rho_a = \frac{k_a}{a_{sa}{}^2}\cdot p_a; \quad (13)$$

$$p_o = p_a + (1+\xi_a)\frac{k_a}{2}\cdot\frac{1}{a_{sa}{}^2}\cdot p_a\cdot\left(\frac{4}{30\pi}\right)^2\cdot\left(\frac{V_s}{D^2}\right)^2\cdot n^2; \quad (14)$$

$$p_o = p_a\left[1 + (1+\xi_a)\frac{k_a}{2}\cdot\left(\frac{4}{30\pi}\right)^2\cdot\left(\frac{V_s}{D^2}\right)^2\cdot\left(\frac{n}{a_{sa}}\right)^2\right]; \quad (15)$$

$$p_a = \frac{1}{1+(1+\xi_a)\frac{k_a}{2}\cdot\left(\frac{4}{30\pi}\right)^2\cdot\left(\frac{V_s}{D^2}\right)^2\cdot\left(\frac{n}{a_{sa}}\right)^2}\cdot p_o = k_1\cdot p_o,$$
$$Where: k_1 = \frac{1}{1+(1+\xi_a)\cdot\frac{k_a}{2}\cdot\left(\frac{4}{30\pi}\right)^2\cdot\left(\frac{V_s}{D^2}\right)^2\cdot\left(\frac{n}{a_{sa}}\right)^2}; \quad (16)$$

Where:
a_{sa} – the speed of the sound in the fluid at the admission in the cylinders; k_a – the medium adiabatic exponent of the admission;
p_a - admission pressure.

Bernoulli's equation between section 0 – 0 and 1 – 1 will be:

$$p_o = p_{ga} + \left(1 + \xi_{ga}\right) \cdot \frac{\rho_{ga}}{2} \cdot W_{ga}{}^2; \; \rho_{ga} = \frac{p_{ga}}{RT_{ga}} = \frac{p_{ga}}{RT_o}, \tag{17}$$

Where:
ρ_{ga} - pressure from the admission gallery; T_o– temperature of the environment; T_{ga} – temperature in the admission gallery.
Applying the relation for the continuity of the mass flow we determine:

$$W_{ga} \cdot A_s \cdot \rho_{ga} = W_a \cdot A_c \cdot \rho_a \tag{18}$$

W_{ga} – the speed of gas flow in the admission gallery will be:

$$\begin{gathered} W_{ga} = \frac{A_c}{A_s} \cdot \frac{\rho_a}{\rho_{ga}} \cdot W_a = \frac{\pi D^2}{4} \cdot \frac{4}{\pi d_o{}^2} \cdot \frac{p_a}{p_{ga}} \cdot \frac{RT_o}{RT_a} \cdot W_a; \\ \mathrm{W_{ga}} = \frac{\mathrm{D}^2}{\mathrm{d_o}^2} \cdot \frac{p_a}{p_{ga}} \cdot \frac{T_o}{T_a} \frac{4}{30\pi} \cdot \frac{V_s}{D^2} \cdot n = \frac{4}{30\pi} \cdot \frac{p_a}{p_{ga}} \cdot \frac{T_o}{T_a} \cdot \frac{V_s}{d_o{}^2} \cdot n; \end{gathered} \tag{19}$$

By introducing the W_{ga} in Bernoulli's equation written for sections 0 – 0 and 1 – 1 it results: [5]

$$\begin{gathered} p_o = p_{ga} + (1 + \xi_{ga}) \frac{p_{ga}}{2RT_o} \cdot \left(\frac{4}{30\pi}\right)^2 \cdot \left(\frac{p_a}{p_{ga}}\right)^2 \cdot \left(\frac{T_o}{T_a}\right)^2 \cdot \left(\frac{V_s}{d_o{}^2}\right)^2 \cdot n^2; \\ p_o = p_{ga} + (1 + \xi_{ga}) \frac{1}{2RT_a} \cdot \left(\frac{4}{30\pi}\right)^2 \cdot \frac{p_a{}^2}{p_{ga}} \cdot \frac{T_o}{T_a} \cdot \left(\frac{V_s}{d_o{}^2}\right) \cdot n^2; \end{gathered} \tag{20}$$

We introduce the relation: $\mathrm{RT_a} = \frac{\mathrm{a_{sa}^2}}{\mathrm{k_a}}$;

$$p_o \cdot p_{ga} = p_{ga}{}^2 + (1 + \xi_{ga}) \frac{k_a}{2a_{sa}^2} \cdot \left(\frac{4}{30\pi}\right)^2 \cdot k_1^2 \cdot p_o{}^2 \cdot \frac{T_o}{T_a} \cdot \left(\frac{V_s}{d_o{}^2}\right)^2 \cdot n^2; \tag{21}$$

We write: $\mathrm{p_a} = \mathrm{k_1} \cdot p_o$; $p_{ga}{}^2 - p_o \cdot p_{ga} + k_2 \cdot p_o{}^2 = 0$.
We solve the second degree equation, with the unknown p_{ga},
where:

$$\begin{gathered} k_2 = \frac{k_a}{2} \cdot k_1^2 \left(1 + \xi_{ga}\right) \cdot \left(\frac{4}{30\pi}\right)^2 \cdot \frac{T_o}{T_a} \cdot \left(\frac{V_s}{d_o{}^2}\right)^2 \cdot \left(\frac{n}{a_{sa}}\right)^2; \quad \mathrm{k_2 > 0;} \\ p_{ga_{1,2}} = \frac{p_o \pm \sqrt{p_o{}^2 - 4k_2 \cdot p_o{}^2}}{2} = \frac{p_o \pm p_o\sqrt{1 - 4k_2}}{2} = \frac{p_o(1 \pm \sqrt{1 - 4k_2})}{2}; \mathrm{k_2 > o;} \\ \sqrt{1 - 4\mathrm{k_2}} \geq 0 \Rightarrow 0 \leq k_2 \leq \frac{1}{4}; \; \mathrm{k_2 = 0;\; n = 0;} \; \Rightarrow \mathrm{p_{ga}} = \frac{\mathrm{p_o(1+1)}}{2} = p_o. \end{gathered} \tag{22}$$

The solution is:

$$p_{ga} = \frac{1 + \sqrt{1 - 4\mathrm{k_2}}}{2} p_o = k_3 \cdot p_o \tag{23}$$

Where: $k_3 = \frac{1+\sqrt{1-4k_2}}{2}$.

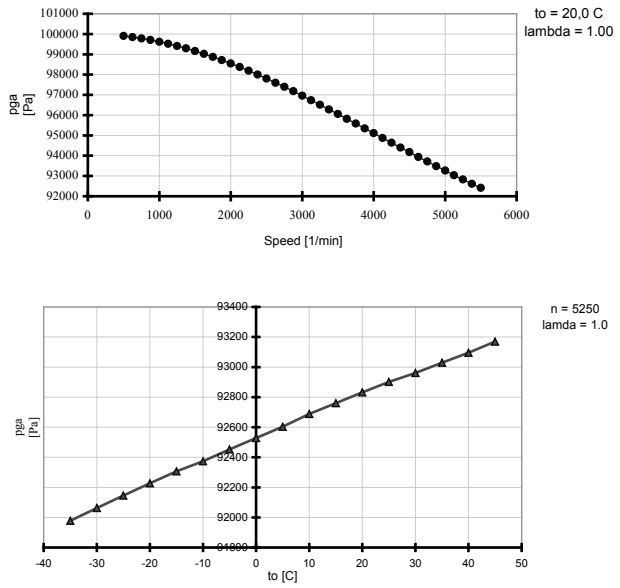

Figure 4. Variation of the pressure from the admission gallery p_{ga} with the number of rotations n and the temperature of the environment t_0

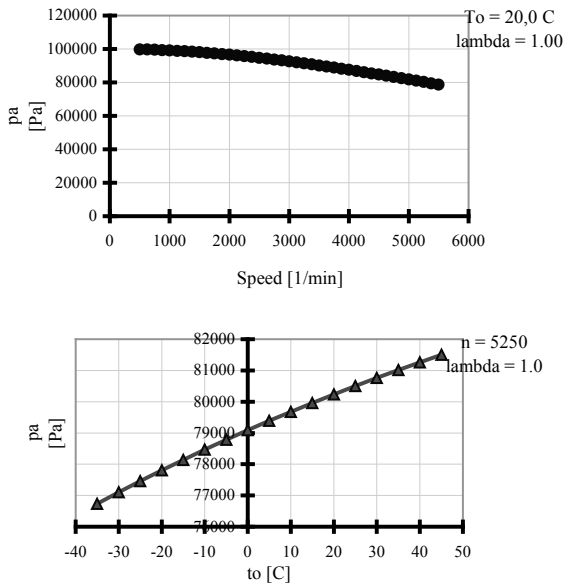

Figure 5. Variation of admission pressure p_a with the number of rotations n and temperature of the environment t_0

Fig. 4 presents the pressure variation from the admission gallery pga with the number of rotations and temperature of the environment, and Fig. 5 presents the admission pressure variation pa with the number of rotations and temperature of the environment from the calculus program.

3. CONCLUSIONS

a, It was devised a personal model for calculating the pressure for the admission gallery pga and for the pressure at the end of admission pa.
b, It was devised the model for calculating the MAS parameters with the gasoline injection with the sub-programs: program for calculus of MAS parameters (dependence after n and λ at t_o=-35...+45ºC and $p_o=1\cdot10^2$ kPa);
The program for calculating the parameters of the SIE (dependence on n and t_0 at λ =1 and $p_0= 1\cdot10^2$ Pa); the program calculating the SIE cycle at the gasoline engine;
c, With the help of the calculus program, we figured the three-dimensional of the adiabatic and polytrophic coefficients, temperatures and pressure in the characteristic points of the cycle, the filling coefficient, the dosage, the heat supply of the capacity of the engine, the pressure growth ratio in the isochoric burning, the volume growth ratio in post burning, the technical-economical parameters of the engine and the length of the injection.

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THE FREE D-ASPARTIC ACID AND D-GLUTAMIC ACID CONTENT OF SHEEP MILK AND SHEEP MILK PRODUCTS

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ABSTRACT

The role of D-amino acids of foods in the human health is a strongly discussed topic and usually, data came from the investigation of cow milk. We have studied the free D-aspartic acid and free D-glutamic acid content of sheep milk, heat-treated sheep milk at various temperatures and various products of sheep milk. Raw sheep milk didn't contain free D-aspartic and D-glutamic acid in remarkable amount and ratio 5.92% free D-aspartic acid; 2.62% free D-glutamic acid). Our heat-treatments didn't cause major change in the free D-aspartic and D-glutamic acid content (max.: 7.8% free D-aspartic acid; 5.3% free D-glutamic acid in total free aspartic and glutamic acid). Contrary, all of the investigated products contained high level of free D-amino acids. The free D-aspartic acid and free D-glutamic acid content of the products were 16,9-39,5%,and 13,3-27% in the percent of total free amino acids. The racemization of aspartic acid was higher, than that of glutamic acid in every product. The D-amino acid content of fermented milk products was higher than in different cheeses.

Keywords: free D-aspartic acid, free D-glutamic acid, sheep milk, dairy products

1. INTRODUCTION

Free D-amino acid content of different foodstuffs are determined basically by the original free D-amino acid content of the raw material, by production methods and by microbiological processes. Several D-amino acid enantiomers may have toxic effect; some may change the biological effect of lisino-alanine as well. On the other hand, certain D-amino acids may be useful (e.g. in pain relief), and proteins containing D-amino acids with reduced digestibility may be used, e.g. in special diets [7]. We learn more and more about the racemization of different peptides and researchers can use modern method to determine the D-amino acids [3, 11, 12, 13, 14].

A number of researchers have analysed the D-amino acid content of milk and various dairy products concluding that D-amino acid content increases significantly during the processing of raw milk. Ref. 1. determined at 100° C, at 7-8 pH , that the half-life of racemisation (time needs to reach 0.33 D/L ratio) for serine is 3 days, 30 days for aspartic acid, 120 days for alanine and 300 days for isoleucine.
Ref. [1] studied the changes of racemization of D-aspartic acid during milk treatments (Hereinafter, we give the concentration of D-amino acids as a percentage of the total - same - free amino acids: D-amino acid (%) = (D/D+L)x100. Raw milk contained the smallest amount of D-aspartic acid (1.48%). However, this amount increased in direct proportion to the number of treatments (acidophilus milk: 2.05%; low fat milk powder: 2.15%; kefir: 2.44%; evaporated milk: 2.49%; yoghurt: 3.12%; milk-based baby formula: 4.95%).
Ref. [9] analysed the effects of heat treatment and bacteria on the content of free D-amino acid in milk and D-amino acid bonded in protein. They determined that the free D-amino acid content did not grow in raw milk under the effects of pasteurisation, ultra-high pasteurisation or sterilization. In contrast, they discovered that the free D-amino acid content of the raw milk samples grew significantly when it was stored at 4° C and thus recommended that the figure for D-alanine content should be used in checking bacterial contamination in milk.
Ref. [11] found the free D-aspartic acid content of milk powder to be between 4-5% and that of D-alanine to be between 8-12%. They measured the D-alanine content of yoghurt at 64-68%, D-aspartic acid at 20-32% and free D-glutamic acid at 53-56%. These values in aged cheese were between 20-45%, 8-35% and 5-22%, respectively. They measured the free D-phenylalanine content of aged cheese as being between 2-13% and even managed to demonstrate the presence of a minimal amount of D-leucine in the aged cheese. Based on their figures, they point out that it is not those foods that are subjected to long periods of heat treatment which contain large amounts of D-amino acids but rather those that undergo microbiological fermentation.

Studying the free D-amino acids in milk, fermented milk, lactic cheese and quarg, [2] determined that significant amount of D-amino acid can be explored both in raw milk and in fermented dairy products.
Ref. [4, 5, 6] studied samples from healthy and mastitic udders. They determined that during milking both samples from the initial streams of milk and those from the diseased udders contained large amounts of D-Asp, D-Glu, D-Ala and D-Ile. The amount and proportion of D-amino acids in milk from the diseased udders grew in line with the Masti-test degrees. These studies prove that the first streams during milking and the milk from cows suffering in subclinical mastitis play a significant role in the amount of D-amino acids in various types of market milk produced from cow's milk.
Ref. [7] investigated the free D-amino acid content of cheeses made using various processes, it was determined that the following free D-amino acids occurred in the following concentrations on average in various cheeses: D-Asp at 58 μmol/100g (30.3%), D-Glu at 117 μmol/100g (15.8%) and D-Ala at 276 μmol/100g (37.2%). A larger D-amino acid content was determined in Cheddar cheese samples, which were made using Lactobacillus species as well.

2. MATERIAL AND METHODS

In our experiments sheep milk samples after different heat-treatments and yoghurt samples were investigated produced in Dairy Lab of Fac. of Engineering University of Szeged. We heated raw sheep milk at 60, 70, 80, 90 and 120° C. Yoghurt was pasteurised at 75° C and then homogenised; and Yo-fast 88 starter (Ch. Hansens, Danmark) was used for fermentation at 45°C.
D-amino acid content of the freeze-dried samples was determined at the Institute of Chemistry of the Faculty of Veterinary Science at the University of Kaposvár by high performance liquid chromatography using fluorenyl-ethyl-chloroformate [3] and by precolumn derivation using chiral reagents o-phthalaldehide/tetra-O-2,3,4,6-tetra-O-acetyl-thio-β-D-glucopyranose [8]. The results are given as free D-amino acids in the percentage of all free amino acids.

3. RESULTS AND DISCUSSION

The ratio of D-aspartic acid and D-glutamic acid were remarkable in samples, therefore we report about results considering these two amino acids.
We found higher amount of D-aspartic acid and D-glutamic acid in heat-treated sheep milk samples compared to raw milk. The changes are illustrated in Fig. 1.

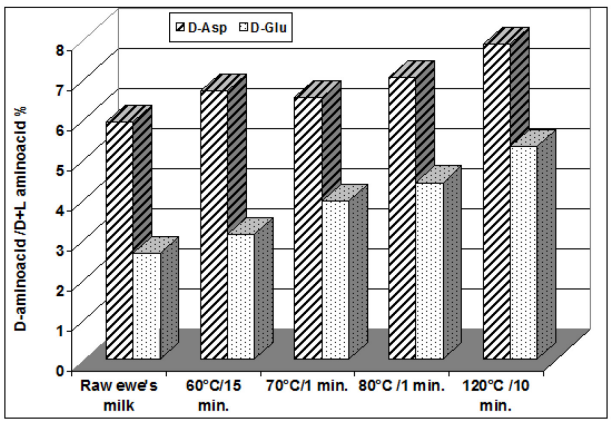

Figure 1. The free D-aspartic acid and D-glutamic acid content of raw sheep milk and sheep milk heat-treated at various temperatures (all data for total D-Asp and D-Glu in %)

However, the heat sensitivities of investigated amino acids seem to be different. Free aspartic acid shows nearly the same increase of D-enantiomers at 60 and 70°C, whereas bigger difference was explored at 80°C. Free D-glutamic acid increase was unambiguous and continuous at each successive temperature. In the case of both amino acids, the highest free D-amino acid content came from samples of highest temperature. The idea of divergent heat sensitivities are suggested, and it is confirmed with the decreased difference between D-aspartic acid and D-glutamic acid (from 3.3% to 2.5% at 120°C, 10 min.).

We can state that the heat treatment (alone) did not result major changes in the free D-aspartic acid and free

D-glutamic acid content of sheep milk compared to the total given free amino acid content (max.: 7.8% D-aspartic acid; 5.3% D-glutamic acid). The effect of investigated heat treatments is demonstrated in Tab. 1. Values are expressed as a proportion of data from raw milk.

Table 1. The growth rate (%) of free D-Aspartic acid and free D-Glutamic acid content resulted by various heat treatments (Value of raw sheep milk=100%)

Amino acids	Heat treatment			
	60° C 15 min.	70° C 1 min.	80° C 1 min.	120° C 10 min.
D-aspartic acid	113.0	110.2	119.0	132.6
D-glutamic acid	117.8	149.9	167.5	201.9

Heat treatment at 60° C for 15 minutes resulted roughly the same change for the two amino acids, but glutamic acid growth was comparatively greater at 70° C. Heat treatment at 120° C (sterilization) resulted 32% increase in D-aspartic acid content while D-glutamic acid content grew by almost 102% (roughly double). Based on the findings came from heat treatments at 70 and 80° C, we can state that temperature increase of 1° C results in an approx. 0.9% increase in D-aspartic acid content and an approx. 1.7% increase in D-glutamic acid content. At same temperature, the speed rate of the racemization of free glutamic acid, was double than that of aspartic acid. Glutamic acid exhibits a greater predisposition for racemisation; D-enantiomer occurs more rapidly and in larger amounts than in the case of aspartic acid. The higher D-aspartic acid content of raw milk suggests, however, that the micro flora prevailing in the udder and/or grown in the milk during cold storage have a greater effect on the condition of aspartic acid.

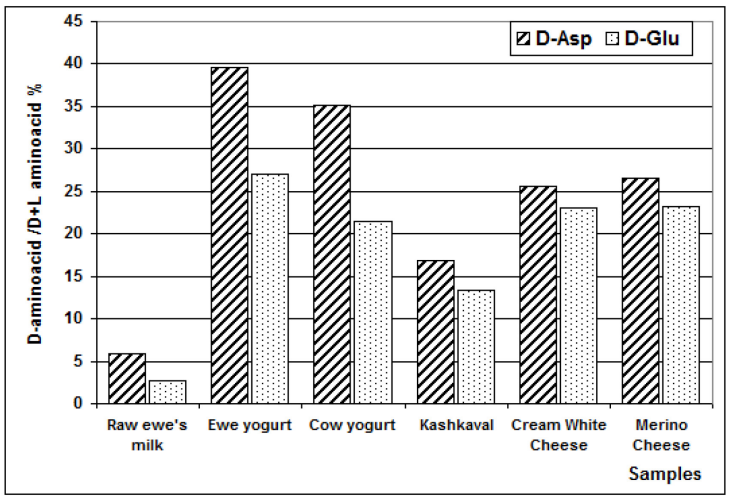

Figure 2. The free D-aspartic acid and D-glutamic acid content of raw sheep milk and certain dairy products (all data for total free D-Asp and D-Glu in %)

Fig. 2 demonstrates our results came from the investigations raw sheep milk and different product made from sheep milk (Pasta filata type cheese as Kashkaval, semi hard cheese as Merino, Cream white cheese made from ultrafiltered milk and yogurts). We can state that all these products contain significantly higher proportion of D-enantiomers than raw sheep milk.

Our findings reinforce the conclusions in the literature suggested that the fermentation of milk with dairy cultures greatly increases free D-amino acid content in dairy products. Values and ratio of D-aspartic acid and D-glutamic acid is represented in Tab. 2.
Of the two amino acids, a higher D-aspartic acid content and a lower D-glutamic acid content was found in all the dairy products. D-amino acid content was roughly the same for traditionally aged cheese (merino)

and acid rennet cream white cheese. The lower values for Kashkaval cheese may have resulted from the heat effect of soaking in warm brine as well as the lower water activity of the cheese.

Table 2. The ratio of free D-aspartic acid and free D-glutamic acid in raw sheep milk and certain products of sheep milk

	D-Asp/D-Glu
Raw sheep milk	2.26
Yoghurt from sheep milk	1.46
Yoghurt (from cow's milk)	1.64
Kashkaval cheese	1.26
Cream white cheese	1.11
Merino cheese	1.14

The yoghurts contained significantly more D-amino acid than cheeses. This may be a result of the higher CFU value and the more intensive bacterial activity. Interestingly, yoghurts representing a pH value of approx. 4.4 exhibited a significantly higher D-Asp/D-Glu ratio than that of cheeses (at 1.11-1.26). This ratio is 1.46 for sheep yoghurt and 1.64 for yoghurt made from cow's milk. Furthermore, the D-Asp/D-Glu ratio was higher in yoghurt made from cow's milk than in yoghurt made from sheep milk. However, we cannot serve correct explanation for this result at present because of the different production conditions (industrial cow's milk yogurt was measured).

At the same time, sheep yoghurt represented a significantly higher D-amino acid content, which can be explained partly by the fact that the total bacteria count is a great deal higher in sheep bulk milk than in cow's milk. Another consequence also can be concluded; likely, the natural, original micro flora of raw sheep milk determines the D-Asp/D-Glu ratio of raw milk. In the other words, at normal condition, the racemization of aspartic acid caused by usual micro flora is deeper, whereas the ratio of D-Asp/D-Glu in products made from sheep milk shows a markedly lower value: 1.11-1.64. It seems likely, that this ratio is determined by many factors as the original micro flora of milk, the processes in the technology and the effect of different starters.

4. CONCLUSION

Many studies proved the presence of D-amino acids in cow's milk and the products made from cow's milk. However, we have not found research concerning sheep milk. Therefore, we have studied the D-amino acid content of sheep milk, sheep milk samples were heat-treated at various temperatures and various products made from sheep milk. According to our findings, raw sheep milk does not have high free D-aspartic acid (5.92%) and free D-glutamic acid (2.62%) content.

Heat treatment did not result remarkable change in the investigated D-amino acid content of sheep milk. In the case of the strongest heat treatment, free D-aspartic acid content increased to 7,85 % and the free D-glutamic acid content reached 5,30 %. In the case of the common pasteurisation of milk, we can state that a temperature increase of 1° C results approx. 0.9% increase of free D-aspartic acid content and approx. 1.7% increase of free D-glutamic acid content.

However, remarkable change of free D-amino acid content was detected in every product samples. The products contained 16.8-39.5% free D-aspartic acid and 13.3-27.0% free D-glutamic acid. We determined the highest free D-amino acid contents in products were made by lactic acid fermentation (yoghurts).

These findings and those of the analyses of samples from the various heat treatments do not enable us to generalise at this point. They call for further study, in particular, to investigate the effect of heating temperature and holding time as well as to gain a better understanding of the precise effects of certain cultures and even individual bacteria species, to ensure that we can keep D-amino acid content of milk products at an acceptably low level.

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THE MEANING OF MONEY LAUNDERING IN BUSINESS LIFE AND THE PREVENTION OF IT

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ABSTARCT

Money laundering is the process whereby the proceeds of crime are transformed into ostensibly legitimate money or other assets. The actuality of the subject derives from the Select Committee on the Evaluation of Anti Money Laundering Measures aided by the Financial Action Task Force. Money obtained from certain crimes, such as extortion, drug trafficking, illegal gambling and tax evasion trough off shore companies as "dirty". The reason of the Committee program is to give aides to those countries which wore not FATF members as money laundering is the most profit yielding business on the world with it's 2800 milliard USD turnover. This organization controls Hungary by supervising the law and overall actions giving a so called Progress Report about the achievements.
In aspect of criminal affairs Money laundering includes all activities which achieve to transform the origin of funds coming from criminal activity as well as tax evasion activity into a legalized form. Money laundering as a phenomenon became a global problem in the second half of the 20th century parallel to sudden increase of drug trafficking. In the past few decades money laundering and the chain of criminal activities as underlying offences got into the scope of the leading economic states. Those activities of money laundering maximally exploit the free movement of capital and financial services. In both the economy and political life there is a need for having laws and regulations against money laundering which rigorously regulate the different financial, bank supervisory activities. According to estimations in the nineties three hundred billion dollars were circulating annually across the world in order to be laundered. Nowadays this figure is well over thousand billion dollars.

Keywords: money laundering, financial action task, terrorist financing

1. INTRODUCTION

Anti-money laundering (AML) is a term mainly used in the financial and legal industries to describe the legal controls that require financial institutions and other regulated entities to prevent or report money laundering activities. Anti-money laundering guidelines came into prominence globally after the September 11, 2001 attacks and the subsequent enactment of the USA PATRIOT Act.
Today, most financial institutions globally, and many non-financial institutions, are required to identify and report transactions of a suspicious nature to the financial intelligence unit in the respective country. For example, a bank must perform due diligence by verifying a customer's identity and monitor transactions for suspicious activity. To do this, many financial institutions utilize the services of special software, and use the services of companies such as C6 to gather information about high risk individuals and organizations. United States federal law for example related to money laundering is implemented under the Bank Secrecy Act as amended by anti-money laundering acts up to the present. Many people have confused Anti-Money Laundering (AML) with Anti-Terrorist Financing (ATF). Under the Bank Secrecy Act of USA, Money Laundering and Terrorist Financing are classified when financial institutions file Suspicious Activity Reports (SAR) to Financial Crimes Enforcement (FinCEN) which is a US government agency. To effectively implement AML and ATF measures, The US government encourages financial institutions to work together for AML and ATF purposes in accordance with Section 314(b) of the USA PATRIOT Act. However, since financial institutions are required by law to protect the privacy of their clients, section 314(b) cooperation has not been generally adopted by financial institutions. To overcome this obstacle, the United Crimes Elimination Network (UCEN) has been established by AML and ATF professionals to achieve this global cooperation goal in compliance with the privacy laws of most countries.
Different countries, depending on the activity, demand different actions [1], [2]. For example; in the US a deposit of US$10,000 or more requires a CTR (Currency Transaction Report) , in Europe it is EUR 15,000, and in Switzerland it is CHF 25,000 in Hungary it is 3,600th HUF requires full identity control. In some countries there is no CTR requirement. Suspicion of ML activity in the US requires the submission of a SAR, while in Switzerland a SAR will only get filed if that activity can be proved. As a result, thousands of SARs are filed daily in the US, while in Switzerland the rate is much lower.

2. FATF: FINANCIAL ACTION TASK FORCE AGAINST MONEY LAUNDERING

Formed in 1989 by the G-7 countries, the Financial Action Task Force on Money Laundering (FATF) is an intergovernmental body whose purpose is to develop and promote an international response to combat money laundering. In October of 2001, FATF expanded its mission to include combating the financing of terrorism. FATF is a policy-making body, which brings together legal, financial and law enforcement experts to achieve national legislation and regulatory AML and CFT reforms. Currently, its membership consists of 31 countries and territories and two regional organizations. In addition, FATF works in collaboration with a number of international bodies and organizations [2.] These entities have observer status with FATF, which does not entitle them to vote, however permits full participation in plenary sessions and working groups. FATF's three primary functions with regard to money laundering are:
i. Monitoring members' progress in implementing anti-money laundering measures
ii. Reviewing and reporting on laundering trends, techniques and countermeasures, and
iii. Promoting the adoption and implementation of FATF anti-money laundering standards global The Financial Action Task Force on Money Laundering (FATF), also known by its French name Groupe d'action financière sur le blanchiment de capitaux (GAFI), is an inter-governmental body founded in 1989 by the G7. The purpose of the FATF is to develop policies to combat money laundering and terrorist financing. The FATF Secretariat is housed at the headquarters of the OECD in Paris. FATF Associate Members include
The FATF currently comprises 34 member jurisdictions and 2 regional organizations, representing most major financial centers in all parts of the globe. – Argentina, Australia ,Austria, Belgium, Brazil, Canada, China, Denmark, European Commission, Finland, France, Germany, Greece, Iceland, India, Ireland, Italy, Japan, Netherlands, Luxembourg, Mexico, New Zealand, Norway, Portugal, Russian Federation, Singapore, South Africa, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.
The Financial Action Task Force (FATF) is an inter-governmental body whose purpose is the development and promotion of policies, both at national and international levels, to combat money laundering and terrorist financing. The Task Force is therefore a "policy-making body" which works to generate the necessary political will to bring about national legislative and regulatory reforms in these areas.
Since its creation the FATF has spearheaded the effort to adopt and implement measures designed to counter the use of the financial system by criminals. It established a series of Recommendations in 1990, revised in 1996 and in 2003 to ensure that they remain up to date and relevant to the evolving threat of money laundering that set out the basic framework for anti-money laundering efforts and are intended to be of universal application.
The FATF monitors members' progress in implementing necessary measures, reviews money laundering and terrorist financing techniques and counter-measures, and promotes the adoption and implementation of appropriate measures globally. In performing these activities, the FATF collaborates with other international bodies involved in combating money laundering and the financing of terrorism..

3. HISTORY OF THE FATF

In response to mounting concern over money laundering, the Financial Action Task Force on Money Laundering (FATF) was established by the G-7 Summit that was held in Paris in 1989 [3]. Recognizing the threat posed to the banking system and to financial institutions, the G-7 Heads of State or Government and President of the European Commission convened the Task Force from the G-7 member States, the European Commission and eight other countries.
The Task Force was given the responsibility of examining money laundering techniques and trends, reviewing the action which had already been taken at a national or international level, and setting out the measures that still needed to be taken to combat money laundering. In April 1990, less than one year after its creation, the FATF issued a report containing a set of *Forty Recommendations*, which provide a comprehensive plan of action needed to fight against money laundering.
In 2001, the development of standards in the fight against terrorist financing was added to the mission of the FATF. In October 2001 the FATF issued the *Eight Special Rec*ommendations to deal with the issue of terrorist financing. The continued evolution of money laundering techniques led the FATF to revise the FATF standards comprehensively in June 2003. In October 2004 the FATF published a Ninth Special Recommendations, further strengthening the agreed international standards for combating money laundering and terrorist financing - the *40+9 Recommendations*.

4. BACKGROUND ON THE MONEYVAL

In 2002, the PC-R-EV formally changed its name to MONEYVAL. MONEYVAL was established in September 1997 by the Committee of Ministers of the Council of Europe to conduct self and mutual assessment exercises of the anti-money laundering measures in place in Council of Europe member states, which are not members of the Financial Action Task Force * (FATF). The effort includes encouraging jurisdictions to improve their anti-money laundering measures in keeping with the FATF Forty + 9 Recommendations and to enhance international co-operation. Currently 28 Council of Europe member States are evaluated by MONEYVAL. In 2006 the Committee of Ministers accepted the application of the State of Israel to join MONEYVAL's terms of reference and Israel has since been evaluated by MONEYVAL. MONEYVAL also engages in a regular typologies exercise focused on the methods and trends of money laundering activity.
MONEYVAL takes into account the practices and procedures of the FATF in its work. MONEYVAL is a sub-committee of the European Committee on Crime Problems of the Council of Europe (CDPC). Each of its member countries is entitled to appoint three experts to MONEYVAL [4]. These individuals are selected based on their expertise in legal issues related to national and international anti-money laundering instruments, supervision of financial institutions, and law enforcement matters. There are thrice-yearly Plenary meetings of the Committee at which the national experts consider and adopt draft mutual evaluation reports and follow up reports of evaluated members of members. Additionally, the MONEYVAL membership also includes experts from the past and current Presidency of the FATF and four scientific experts appointed by the Secretary General.
When MONEYVAL (then called PC-R-EV) was formed in 1997, a document containing the terms of reference for the Committee was agreed at the same time. The Terms of Reference have since been amended to extend the mandate of the Committee until 31 December 2010. The amended Terms of Reference also permit FATF member countries to participate as observers in the work of the Committee.

5. ASPECTS FOR EU MEMBER STATES

The European Union is also active in the formation of institutional system against money laundering [5]. On the basis of the FATF recommendations it has adopted its directives that have to be implemented by the EU member states. In Hungary the Parliament adopted the Act CXXXVI of 2007 on the Prevention and Combating of Money Laundering and Terrorist Financing (AML/CFT Act) that implements the Third EU AML/CFT Directive (Directive 2005/60/EC of the European Parliament and of the Council on the prevention of the use of the financial system for the purpose of money laundering and terrorist financing) into the national legislation. The EU directive 2005/60/EC "on the prevention of the use of the financial system for the purpose of money laundering and terrorist financing" tries to prevent such crime by requiring banks, real estate agents and many more companies to investigate and report usage of cash in excess of €15,000. The earlier EU directives 91/308/EEC and 2001/97/EC also relate to money laundering. The European Union is currently negotiating a New 4 th Anti – Money Laundering Directive that will change the nature of anti-money laundering compliance across the European Union.

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THE OPERATION OF AN EMERGENCY MEDICAL DEPARTMENT IN A COUNTY HOSPITAL FROM A LOGISTIC POINT OF VIEW

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ABSTARCT

The purpose of this article is to give an overview of the actual emergency medical attendance through an exemplary hospital in Hungary, highlighting its possible imperfections which could perhaps be improved through further structural developments. In order to be expressive, the article follows through the journey of two nominal patients who turned up in the emergency department of the hospital. The importance of this topic is expressed by the fitful judgment of the emergency attendance. Emergency service had already existed in the United States, only later then did the one-entrance service system start to develop Hungary. In some places this system has been working well for decades, but for instance at the University of Szeged – due to the uncertain judgment of the system – the construction is just being finalized, right at the time when such studies are published that question the reason of existence of the emergency departments – at least in their actual form.

Keywords: emergency, logistics, hospital, Székesfehérvár, medical care, SBO EMD

1. INTRODUCTION

The annual patient traffic of the department of emergency medical care at Fejér Megyei Szent György Egyetemi Oktató Kórház (Fejér County Saint George University Teaching Hospital) [7] in Székesfehérvár is 33.000 persons, as it can be read on the hospital's website.

Figure 1. Fejér County Saint George University Teaching Hospital [7]

The source states that the total number of the population attended by it is 420.000 persons. It can be concluded from these two numbers that each twelth person of the population concerned, which is 4,2% of the country's total population visit the emergency unit every year. According to the data it means 92 patients daily, around the clock, let it be a weekday, weekend or holiday. However, this number is experienced to show an outdated state. In the last six months or year there was hardly a day when the patient traffic was under a hundred. The number of the staff for this number of patients is distributed in the following way. Three of four surgeries work steadily. There is a doctor and an assistant in each of them. As a regular basis, in the fourth surgery there is a doctor in the most frequented period from the aspect of patient traffic: between noon and eight p.m. This time one of the assistants, for practical reasons the one in the middle surgery, works both in his/her own and in the fourth surgery, too. To understand this logic we are sketching the spatial location of the department, especially the surgeries. Coming from the entrance the doors of three surgeries open on the left, while the fourth from the right. The three surgeries on the left are joined by doors. So, when the fourth surgery operates actively, the temporary lack of the nurse in the middle surgery is compensated by the two assistants in the side surgeries. The triage nurse (expert in the first-aid rescue who assesses the general status) is the organic part of the staff. Besides doctors and nurses,

it would be fairly difficult to define the number of staff because they do not belong to the department directly. The hospital porters are assigned centrally but they, together with the cleaning staff, work in a continuous shift of 0-24. In case of a patient traffic of this kind it can be stated with reason that the department can work only in a well-organized structure which has not only financial and human resources conditions. It is also a fluently operating logistic system which, in this case, is not employed in securing pharmaceutical products and appliances though it is of the same importance, it is not specific from the view of the department of emergency medical care-but it sorts out the patients coming. The importance of the topic is emphasized not only because of the suitable use of hospital resources but it is underlined from the patient's aspect, as well, since the emergency unit – 'nomen est omen' – gives a quick treatment, even though originally the name itself would not refer to it. It can be concluded that it generates of dissatisfaction of high level if the patient has to wait long hours in the department waiting room.

2. THE SUBJECT IN DETAILS

The task of the Emergency Medical Department /EMD/ (in Hungarian Sürgősségi Betegellátó Osztály /SBO/) [8] – which has been formulated by themselves for themselves, is 'to accept patients with or without a referral, arriving either on foot or in ambulance twenty-four hours a day. Regardless of the referral or the way of the arrival the EMD complete an assessment of general status.' It also means that for the department this assessment, apart from the patient's status (explained later), is absolutely a loss of resources either in money, in human resources or in time, even though it is not in unit or the same degree. To sort out the cases which are more urgent than the other urgent or the totally groundless ones it requires highly-qualified experts with serious experiences. First, we are aiming to show the way in two separate fictitious cases which the patient go through until he/she leaves the department [5].

Figure 2. The entrance to EMD [8]

2.1. The first case

The first case is a young female patient in her thirties whose stomach starts to ache at home on Friday. The painkiller stops the stomachache at home but it reappears again and again during the weekend. The pain is durable first with one dose of painkillers and then with a double dose, so she spends her time with her family comfortably in an armchair. Then, on Monday morning when she wants to go to work her pain is still there which disturbs her in her activities so the 'well-informed' woman, who knows the tasks of the emergency department fairly well, decides to go to the EMD of the hospital. She leaves her home accompanied with her partner by car; the parking lot is about 150 meters away from the hospital, so they have to walk to the entrance. Entering the building they go to the reception right next to the entrance. Here, the patient gives her social security card to the officer sitting in front of the computer, and then they are asked to sit down in the waiting room. At 8.30 a.m. on Monday morning there are around 10-15 patients together with their relatives in the waiting room. In the meantime, the details about the patient are entered into the computer. So far, there is no information about it, it should be waited. The door of the triage room opens, the patient is called. The woman enters, and the assistant there asks her what the matter is. Her name, the date of birth, the security card number are written on the left upper corner of an envelope, which will contain every single document of the patient, the arrival time in the middle, while the complaint in the

right upper corner. According to the patient's story the following sentences are written there:' Stomachache for 3 days. No vomits. No diarrhea [3]. After a few compulsory questions or in the meantime, regarding the number of patients in the waiting room, the nurse does the ECG which she puts into the envelope, measures the patient's oxygen saturation and blood pressure which values are written on the envelope. Then it is followed by the most important mark which is written next to the previous data, under the arrival time: IV. It is the triage nurse's task to sort out the patients on the basis of the questions and basic parameters. The cases which need immediate treatment belong to group me, while the not so urgent ones to group IV. Cases between them belong to groups II or III. After that our female patient is asked to take a seat in the waiting room while the triage nurse carries the envelope into one of the central surgeries. By 'central' I mean that from this surgery the doctors can enter two of the four ones, so it is easily accessible for them. Here, the nurse puts down the envelope on the pile of the ones marked with IV. The patient has to wait until one of doctors seizes the envelope with her name on it and takes it into his/her own surgery and asks her to enter there. So, it is important to know the logistics of envelope picking. From this aspect the complaints written on the envelope, blood pressure, oxygen saturation or the age of the patient are not important. There are two factors which the doctor weighs: the number which shows the state of urgency and the arrival time. To make the things simpler, we disregard the case that if there is a cardiologist working in one of the surgeries, it is obvious that the patient with complaints in the chest will be examined by him/her, in spite of fact that a case like this can be treated by everyone working there. So we suppose that each doctor going to the table with the envelopes has a specialist examination on emergency medical treatment. The selection in the first round is done by the HiFo system so the doctor chooses the case with the highest emergency grade. It is a small but solvable contradiction that the highest grade is the grade I and as this number rises so the grade of the emergency decreases. What happens in case of equal points? Then they change to the FiFo system which means from cases with the same emergency grade they choose the one which arrived earlier. Our patient who has a stomachache and was sorted to the grade IV has to wait until each case with grades I, II, III and also those who arrived earlier are examined. Naturally, each patient with grades I, II, III who arrives in the meantime changes this potential order. After our patients gets into the surgery which actually takes around an hour the doctor queries her, uploads the anamnesis into the computer, examines her and then takes notes about the present status of the patient. Then, he/she tries to arrange the necessary examinations. While the assistant takes a specimen of her blood, the doctor orders the laboratory tests via the computer system. It is the hospital porter who carries the test-tubes with the blood to the hospital's central laboratory from where the results will be shown for the doctor on the computer. Besides, the doctor sends the woman to an abdominal ultrasonic examination because of the pain in her stomach. He/she orders the desired examination via the computer network, the patient is accompanied by the hospital porter to the hospital's radiology where they complete the examination, and then the doctor can see the results on the monitor, ideally even when the patients is again in the waiting room of the department. Obviously, during these examinations the doctor begins other cases, as well, since there should be no dead time, so it can easily happen that the doctor treats five or six patients at the same time. Obviously, it means that the female patient with a stomachache cannot enter to the doctor immediately after arriving back from the ultrasonic examination, since he/she queries or examines the other (third or fourth) patient and arranges the next steps of his/her diagnostics. For the patient it is naturally a wasted time and probably not the only one. When she enters to the doctor again, he/she knows the results though he/she cannot close the case and asks for a medical consultation with a surgeon. While she waits for the specialist, she sits in the waiting room and the doctor is occupied with the next patient. When the surgeon arrives, the woman enters the surgery again; they examine her stomach, but do not find a severe, urgent inflammation or intestinal obstruction. The patient takes a seat in the waiting room again. Her emergency practitioner is aware of each information after the surgical consultation to state that the present menstrual spasms, revealed at the time of anamnesis, are in the background of the symptoms, so after the necessary documentation the patient can leave for home.

2.2. The second case

Our second patient is a man in his sixties whose side, while raking in their garden in Dunaújváros, weakens unexpectedly and then he falls down. His wife runs to him but the man can neither understand her words nor talk though he is seemingly attentive. She calls the ambulance that arrives to him in a short time. After assessing the patient's status they have to decide where to take the man. Before the era of emergency departments, the one-gate patient traffic the paramedics had to decide which hospital and which department they should take this man. It is an easier decision where the out patients' departments were within the same

building, or in a fortunate case, next to each other but for example, in the clinic of the University of Szeged the department of neurology is not even in the same campus than those of surgery or internal medicine [6]. The system of one-gate emergency departments surmounts this situation where, regardless of what symptoms the paramedics observe, they take the patient directly to the EMD and the specialists are asked to go there to examine the case. Anyway, it is only the psychiatry which does not belong to this system for several professional reasons. In the present case, in this system, which does not cover the whole country, the paramedic has to decide where to take the patient for completely another reason. Using his professional experience and knowledge he/she assessed that they man has stroke. While the general neurologic care is accessible in most hospitals countrywide, so is in the hospital of Dunaújváros, but the stroke centre which gives a specific therapy – using systematic intravenous thrombolyses – can be found in Székesfehérvár, as the nearest. So the paramedic decides and goes directly to the Town of Kings. At the arrival the paramedics say that they have brought a patient and the triage nurse immediately sorts him as grade I. After a doctor examines him and ascertains that the symptoms started fifty minutes before, he starts to arrange the aforementioned lyses which has to be given to the patient within 4,5 hours. It is when the logistic race with the time starts. Preparing for the lyses, the patient is taken to the intensive department of the EMD. It is important to mention here that the process detailed as follows is accomplished even though a part of the candidates for the lyses does not get the treatment because of the contraindications revealed during the process. Now, I will not detail these professional principles. They take a specimen of the patient's blood for the further laboratory tests in the intensive department of the EMD. Meanwhile, a cranium CT-examination is asked in agreement with the cardiology, where the hospital porter takes the patient and the doctor working in the intensive department calls the neurologist working in the building three hundred meters away from him/her. By the time the neurologist finishes the call, the CT-images are in the computer system, in an ideal case, so he/she can observe them. If he/she sees bleeding, the lyses is contraindicated and order the patient to the department. The hospital porters take the patient with vehicles for ambulance service between the buildings, so he leaves the emergency department. If no bleeding can be seen on the CT, the neurologist heads to the emergency department. He/she examines the patient and the laboratory results and decides if the lyses can be started. If so, the patient will stay in the intensive department of EMD for the following 24 hours. The dosage of the specific medicine is followed by the time of observation of this length. Then, a new cranium CT-image is taken then the patient is taken to the neurology department by the aforementioned hospital porters and their vehicle.

2.3. Solutions

In the cases detailed above the improvement of the logistic system is of more components. In the first case, the purpose is to decrease both the waiting time and the burden put on the doctors working in the department. In the second case, the main point is to allow the patient to have the specific therapy as soon as possible due to the extremely time-sensitive factor of the treatment.

Decrease of the waiting time is a crucial issue in other hospitals abroad, as well. Some of them present this data as the most important value of the patient's satisfaction. The Dutch University of Twente in Enschede set as an aim in their 2012 study that they intend to decrease this value in opposition of the principle that development of the network of medical advisers can relieve the emergency departments thus lessening the waiting time. They started from factors which they can influence by the structural and organizational transformation of the local EMD. They found out that a simple method like the practice that it is the triage nurse who orders the necessary laboratory tests lessened the gross (the total) waiting time with almost 9,5 minutes [2]. It increased the time spent at the triage nurse with only one and a half minute. The same study emphasizes the simple fact that the practical outlay of the EMD can decrease the waiting time, too. It is easy to imagine that the neurological consultation is slower in the hospital of Székesfehérvár since the neurologist starts from a street-like distance than if there were a neurologist working steadily in the emergency department. On the basis of similar principles, the Dutch study underlines the importance of surgeons as they have observed that they are needed for the 54% of the cases. [2] Though there is no similar survey in the Saint George Hospital, the workers in the EMD think that this high rate is not experienced there. Forcing the defensive medicine back would decrease the waiting time but it also would have a financial consequence, too. The menstrual spasm of the female patient with a stomache seemed to be potential even at the time of anamnesis; nevertheless she was given a thorough examination.

In case of our elderly male patient with a stroke the change in logistics may arise in a completely different field, actually in the ambulance level. Since it can easily be asked if the paramedics recognize the situation, namely the patient has embolism in the brain and has to be taken to the stroke centre, why should not they

transport him directly to the hospital? Probably, the requirements according to the professional rules are provided in a better level in the intensive unit of the emergency department. Would not it be worth improving the infrastructure in order to decrease the loss of time?
These are special cases, however, in general we have to refer back to the roots of the problem, namely to the basic health care. The Hungarian studies on this subject claim without doubt that the present emergency service is not efficient the reason for which have multiple sides. Among others, the number of groundless claims is high which happens because the population is under informed and they have a kind of 'I deserve it'-attitude [4]. The professionals often experience parallel alarms when both the doctor on duty and the ambulance are called at the same time. Turning back to the professional field, the study finds the number of the present professional principles low. A well-formed protocol which meets the highest professional requirements can certainly improve the service [1].

3. SUMMARY

The present emergency medical attendance is not efficient enough according to both the Hungarian and international specialized literature or at least it could be organized in other forms. Simple modifications, like that the triage nurse orders the laboratory tests, can improve the efficiency to a greater extent, other developments of large volume like for example, the transformation of the system of family doctors would increase efficiency in an unacceptable degree. We think that one of the most striking problems is that the present emergency departments have been established in old building complexes. It means that the disunity of the specialized areas of medicine – for example the distance of the neurology department from the main building in Székesfehérvár – results in serious logistic problems for both the doctors and the patient.

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THE RELATIONSHIP BETWEEN AGRICULTURAL STRATEGY AND INTEGRATION IN THE POULTRY INDUSTRY

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ABSTRACT

Agricultural strategy has always played a major role in the development of agriculture. Its role is perceivable when reviewing the state of the integration of the poultry industry before and after the transition of the political system. Before the transition, both horizontal and vertical integration solutions were present in the poultry industry in Hungary, however, after the transition only vertical integration solutions remained. The current agricultural strategy (National Rural Strategy 2012-2020) and the sectoral strategy developed by the PPC (Hungarian Poultry Product Council) lays great emphasis on the promotion of forms of integration in accordance with the objectives of the CAP 2014-2020. The level of integration of the poultry industry in Hungary has not yet reached that of Western Europe, as in [1], therefore it is very important to support the existing forms of integration in this sector and to encourage the establishment of further integration.

Keywords: vertical integration, horizontal integration, poultry industry, sectoral strategy, national rural strategy

1. INTRODUCTION

Starting with the 1960s, the main objectives were to improve the status of agriculture and to raise production levels in addition to complex technical development, unlike the Soviet model. The large-scale restructuring, the organization of the foundations of farming was launched in the 1960s and 1970s, and spectacular growth and yield growth had taken place until 1985, but then after 1986 the period of stagnation, the depletion of accumulated assets and resources began, as in [17]. In terms of the quantitative indicators of the agricultural sector, agriculture during this period can be described as dynamically developing, however, the situation is worse if, instead of a merely quantitative comparison, the efficiency of agricultural production is analyzed in a complex way and compared to international data, as in [4]. After the transition of the political system, radical changes occurred in the ownership, organizational, management, production, market and employment relations of the agribusiness sector in Hungary (as a result of restitution, privatization, deregulation and liberalization, and the transformation of cooperatives). The former agricultural wealth and assets, and the technical and technological background of production became fragmented due to restitution and privatization, and the pre-existing vertical and horizontal system of relations in the agribusiness sector disintegrated. The bargaining power of the fragmented producers greatly weakened relative to the more powerful highly capitalized processors and traders, as in [18]. In Hungary the conditions of integration were also made difficult because agricultural transition was not accompanied by the preparation of a modern agricultural strategy, as in [2], thus agricultural policy only marginally supported integration since the transition of the political system, but it would be important to lay emphasis on supporting integration in order to improve competitiveness, as in [16].

2. MATERIALS AND METHODS

The article is a theoretical summary of the presentation of the different national historical development paths of vertical and horizontal integration in the periods before and after the transition of the political system. The status of the current vertical integration of the domestic poultry industry is examined on the basis of secondary research findings, and the stimulating steps taken so far in agricultural policy to support vertical integration in the domestic poultry industry are identified and assessed based on data collected by the author.

3. RESULTS AND DISCUSSION

Two large groups of integrated organizations had a significant role, that is, production systems in terms of horizontal integration, and in terms of vertical integration, Bábolnai Mezőgazdasági Kombinát (Agricultural Combine of Bábolna) and Nádudvari Vörös Csillag Mezőgazdasági Termelő Szövetkezet (Red Star Agricultural Cooperative of Nádudvar), and the integratory activities of poultry processing plants were significant.

According to [6] one of the motives of horizontal integration (the establishment of production systems) is speed, that is, the time for acquiring a high level of expertise accumulated over many years may be reduced, and the use of financial and intellectual services involved in the production process can become feasible at lower costs and with greater efficiency. Another motive is to preserve the independence of the creators, because they will continue to actively participate in the decision-making regarding the integrated activities. The advantage of horizontal integration (production systems) is, therefore, that it preserves the flexibility of independently managed systems, and through high standards of expertise and technology it increases the efficiency of investments.

The objective of production systems is to achieve faster than average growth in the area under integration with the help of leading cutting-edge production technology, and a high level of expertise. Firstly, in production systems advocacy was implemented on a sectoral (branch) level, secondly, the development of the sector (branch) accelerated within the framework of integration, and thirdly, the optimization of agricultural production was attempted. Far-reaching coordination was implemented in the production systems, and extremely strict work discipline prevailed, and subsequently there was a significant increase in yield levels, as in [14]. In 1976 in Hungarian agriculture "21 arable crops production, 13 livestock and 20 horticultural systems operated. 90% of collective farms and 70% of cooperatives were members of some production system" (as in [6], p. 92). In 1982, a total of 75 production systems operated: 21 arable crops, 24 livestock and 29 horticultural systems, as in [13].

In animal husbandry in the poultry sector the production systems achieved outstanding results, as in [6]. However, regarding the operation of production systems several negative aspects can be identified. One of these is the conflict of interests between the systems centre and the member farms, as the systems centre was interested in increasing the average yield, while its members were interested in achieving the net revenue per area unit, as in [14]. On the other hand, a gradual increase in the average yield also resulted in the increase of expenses, production cost and cost price, therefore the production systems could produce a lot, but at a high expense, as in [13]. "The economy of livestock production was no better on the farms joining the livestock production system than on the farms outside the system, with the exception of the poultry sector" (as in [15], p. 394). Higher costs resulted in no improvement in quality either. Thirdly, in the seventies the organization of production systems became rather common, which also enabled weaker farms to become members of production systems. A further loss was the termination of foreign currency loans. All these contributed to the fact that the development of production systems halted in the early eighties.

Ref. [8] contains that combines and mergers/partnerships played a key role in vertical integration. Combines were large companies engaged in vertical production which controlled the entire production and distribution chain from breeding livestock and seeds, through production and processing to the production of technologies and sales. In mergers/partnerships the member companies operated independently in addition to the division of the phases of production among themselves, and played an important role in the integration of small-scale farming.

Since the mid-1970s large agricultural holdings played an important role in the organized integration of small-scale production as they helped small-scale farmers by providing breeding stock, feed and veterinary care, and organized production and sales, by which they played an important role in the stabilization and development of small-scale farming. In the eighties the outsourcing of the livestock in large agricultural holdings to small-scale producers, to domestic farms unfolded. As a result of integrated production, production in large agricultural holdings accounted for two thirds of agricultural production, and domestic farms provided nearly one third thereof, as in [13]. In 1982 large agricultural holdings produced nearly 70% of the feed and 90% of the day-old poultry used by small-scale producers, as in [8].

According to Ref. [8] after the transition of the political system, this ratio reversed, and poultry production that decreased in volume, for the most part was widely provided by private producers, and its integration was provided by processing plants. They supplied day-old poultry and feed on credit, and provided professional consultancy. Integrators were faced with the problem of financing production, as the majority of their current capital requirements were covered by loans. The interest on the loans was transferred to the producers by subtracting it from the purchase price.

In the second third of the nineties, a strong process of concentration occurred among the companies, and the domestic market was characterized by strong competition between the strongest players in the market (Bábolnai Baromfi Rt., Hajdúsági Baromfitermelő Rt., Hungavis Rt./Conavis Kft). The combined domestic market share of Bábolnai Baromfi Rt. and Hajdúsági Baromfitermelő Rt. was 40%, and their share of exports was 56%, as in [10]. After 1997 the market became polarized, one pole being Bábolna Rt., the other pole being Hajdú-Bét Rt., which in 1997 acquired Conavis Ltd. in addition to English/American

capital investment. In 1998 Bábolna Rt. accounted for one fifth of domestic poultry processing, while Hajdú-Bét Rt. over 35%, their combined export market share reached 60%, as in [12]. Production in the poultry sector was characterized by a high degree of integration in this period.

However, during the period between 1999 and 2006, players in the poultry industry that were significant in the 1990s, some of the integrated domestic groups of companies (Carnex Bábolna, Hajdú-Bét) went bankrupt one after the other, as in [9]. This occurred because the status of the sector was aggravated by several factors. The first factor was the crisis of the Russian market. Its effects could already be felt since the summer of 1998, when 35 thousand tonnes of stock accumulated at the poultry processors. In the meanwhile, some producers' output was still growing, which was due to the investment support scheme (promoting capacity increase of producers and processors). The situation was worsened by the sudden saturation of Hungary's EU export markets and the drop in prices resulting from that. In order to solve the situation, the economic policy reacted by drastically decreasing subsidies (both direct subsidies and investment aids) instead of encouraging producers to move towards reasonable and coordinated production cuts. All this led to a general crisis in the sector, as in [18].

The second factor was the accession to the European Union, because after the accession, the poultry sector, being a "lightly regulated" sector, lost sector specific national subsidies it had previously received, and the producers in the sector had access only to very limited forms of assistance, e.g. within the framework of support for young farmers or within the framework of central contribution to investments aiming at environmental protection and animal welfare (but not at increasing the actual production). Due to the European animal husbandry requirements (animal welfare measures) and the more stringent animal health standards domestic poultry meat production decreased. Reference [11] contains a comparison of changes induced by the accession to the EU to the ones of the transition period, because the state gradually withdrew from the support system, competition intensified for every participant of the product chain, cooperation among them was at a low level and they were slow and unwilling to adapt to the market challenges.

The third factor was the drop in domestic demand for poultry products as a result of misleading information on the bird flu epidemic starting in the autumn of 2005, and the reduction of the purchase price. As a consequence, many farmers paused or stopped production. Processors had an opportunity to get rid of their unsaleable stocks only later and at low, depressed prices. The gap was filled up by importing cheap chicken meat from Brazil and Thailand. Because of precautionary animal health measures and the withdrawal of producers, the poultry flock was reduced, as in [9].

The National Rural Development Plan (2004-2006) for example, defines the support of producer groups as a measure, but during the implementation of the National Rural Development Plan in 2004 only a modest sum could be devoted to supporting producer groups due to the high requirements of the regulations. The measures planned under the New Hungary Rural Development Programme (2007-2013) also featured support for producer groups within the first axis of improving the competitiveness of the agricultural and forestry sectors, in which the establishment of approximately 100 new producer groups in the country was envisaged, within the wine, milk, and meat production sectors. As a result of this objective, by 2010 only 13 new producer groups had been formed, as in [19].

The current agricultural strategy (National Rural Strategy 2012-2020) in accordance with the objectives of the CAP 2014-2020, lays a strong emphasis on promoting the cooperation of forms of integration. The encouragement of vertical forms of integration that cover the product line is featured in the current agricultural strategy under the cooperation (partnership) development programme aimed at encouraging the establishment and operation of cooperatives.

The objectives include the promotion of cooperation among partnerships, forms of integration, assistance in establishing cooperative relationship networks and secondary and tertiary cooperatives; the development of a grassroots national system of cooperatives/partnerships, as in [20]. However, the method of implementation of the strategic goals formulated in the National Rural Strategy is not detailed in Darányi Ignác Plan (the framework programme for the implementation of the National Rural Strategy).

4. CONCLUSIONS

The level of integration of the poultry industry in Hungary has not yet reached that of Western Europe, 50% the total broiler flock is produced by farms with livestock populations of under 50,000 birds (KSH [Hungarian Central Statistical Office], (Agricultural Census 2010, data as of 1 June 2010), as in [1]. In the case of the broiler chicken the situation is better because 73.94% of the livestock is produced by farms deemed viable with over 50,000 birds, which in turn represents only 0.9% of broiler chicken farms (Fig. 1).

Hungary still has a high level of fragmentation, the majority of broiler chicken farms, 93.43% raise less than 5,000 birds, but only 21.09% of the livestock falls into this category (Fig. 1).

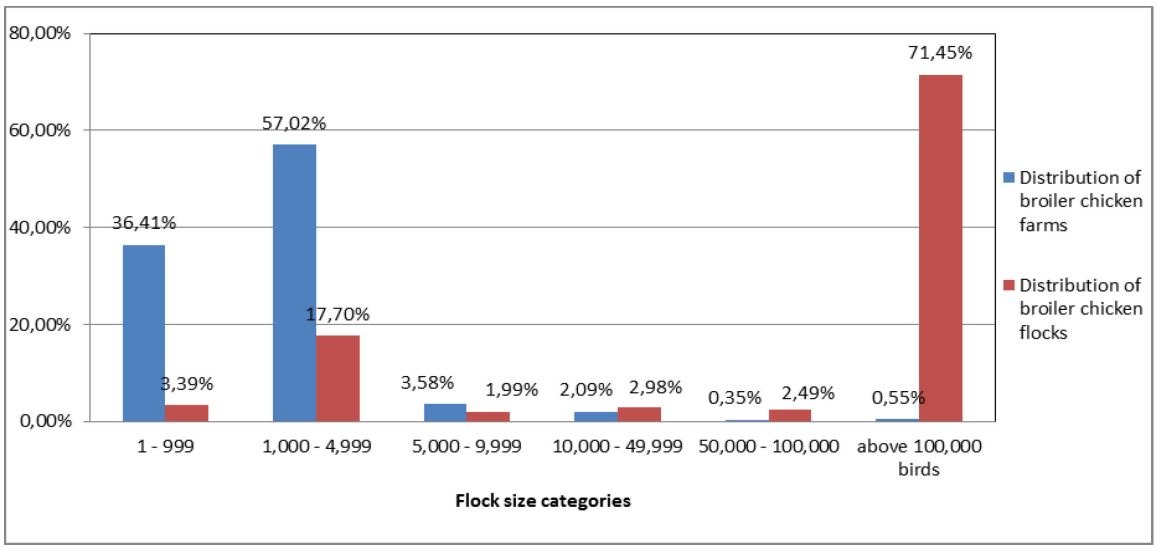

Figure 1. Distribution of broiler chicken farms and broiler chicken populations in size classes (Source: Hungarian Central Statistical Office (KSH), Agricultural Census 2010, 1 June 2010, edited by author)

By supporting integration by the national economy, the vulnerability of our market could definitely be reduced. However, in Hungary some more appropriate technological tools should be used to ensure economic and competitive broiler production. However, it could only be used economically in a large amount of livestock. Technological backwardness and small livestock sizes are also responsible for low natural efficiency indicators (Tab. 1).

Table 1. Comparison of the natural efficiency of broiler production (Source: Industrial Strategy of the Hungarian Poultry Product Council (BTT) from 2014 to 2020)

Natural efficiency indicators	EMSLAND (Germany) broiler integration average in 2012	Hungarian average in 2012
Mortality (%)	3.01	4.40
Average slaughter weight (kg/chicken or bird)	2.43	2.35
Feed conversion ratio (kg/kg)	1.61	1.88
Average slaughter age (day)	39.20	41.30
Average daily weight gain (g/day)	62.09	58.00

The production costs related to broiler production are high in Hungary, because the costs of protein sources, energy and labour are higher here than, e.g. in Brazil or in the USA. Due to the European Union there are stricter animal health and environmental requirements. Basic material production is also hindered by the fact that crop production and animal husbandry have separated and most farms do not own any cropland and cannot produce the necessary amount of feed. The disposal of manure is also a problem. Given the geographical situation of Hungary poultry meat export is more costly due to transport costs, as in [9] and [7]. The low level of interest advocacy in the sector is also a barrier to competitiveness, as in [7] and [1].

Reviewing the problems of the sector it can be observed that the establishment of a sectoral strategy was already very pressing. According to the seven-year development strategy developed by the Poultry Product Council, HUF315 billion of investment is necessary in the sector between 2014 and 2020 to significantly improve the positions of the poultry market players, and to increase the competitiveness of the sector. As a result of the strategy, restraining the gradually increasing imports would be feasible as well (Fig. 2).

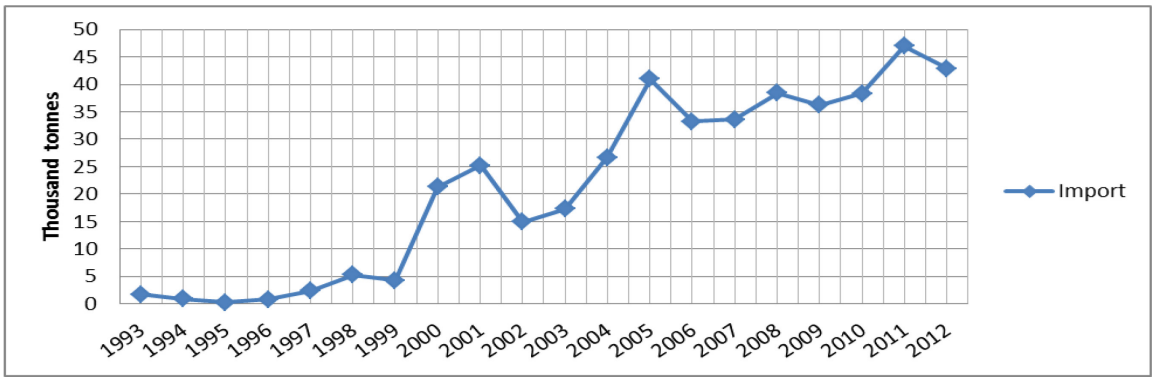

Figure 2. Changes in poultry meat imports (Source: KSH – carcase weight)

One basic requirement of the strategy is the radical reduction of VAT, that is, the reduction of the VAT rate to 5% on meat and poultry products. The previous increase in the VAT rate held back domestic consumption because of the rise in consumer prices (Fig. 3) and strengthened the grey and black economies, which are estimated by the PPC to have increased from 15-25% to 35% within the sector. The radical reduction in the VAT rate on the one hand would help increase domestic demand for the products of the sector, and on the other hand, it would reduce the existing share of the grey and black economies which hinders concentration processes.

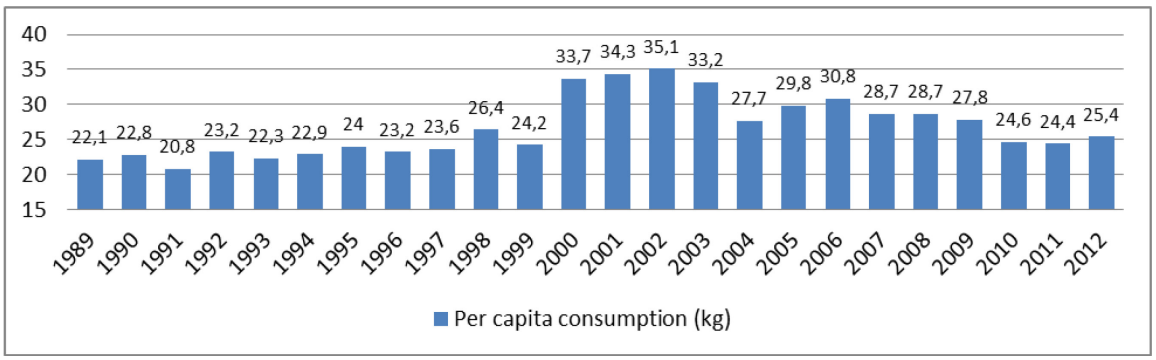

Figure 3. Changes in Hungarian poultry consumption per capita (Source: KSH)

One of the subsequent pillars of the strategy is to raise poultry welfare grants to HUF10 billion, as well as to strengthen integration in the sector. The primary objective of the investment programme is the modernization of the production of raw materials (reconstruction of building stock, development of breeding technology), especially for businesses with an integratory background. Thus, the support of integration was given a key role in the sectoral strategy, which is quite relevant, as it forms the basis of a competitive and efficient economy. The sectoral strategy is in line with the objectives of the CAP 2014-2020 and the National Rural Strategy as well in promoting integration. Therefore, support for integration is the basis for future competitiveness, as Hungary's goal is that similarly to the eighties, the poultry sector could again become one of the thriving sectors of Hungarian animal husbandry.

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VERIFICATION OF BERNOULLI LAW USING THE SOFTWARE AUTODESK SIMULATION CFD

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ABSTRACT

Using Fluid Dynamics Analysis (CFD) provides the opportunity to achieve a faster and more thorough study of fluid flow processes and is an important step to obtain information that cannot be obtained otherwise. The finite element method is generally more accurate than the finite volume method, but finite volume method can achieve more accurate mass balances using the balance sheet continuity per volume control. Finite volume method is more appropriate when fluid transport, while the finite element method is used more in the calculations of tension or conduction, which satisfies local continuity condition, is of less importance. Fluid Dynamics Analysis (CFD) is used in numerical analyzes, based on a set of mathematical expressions on linear complex equations defining fundamental fluid flow and heat transfer. This paper presents the simulation of air flow through a tube of special construction in interpreting the law of Bernoulli energy. Laboratory systems are shown, respectively simulating the actual fluid flow.

Keywords: Bernoulli, simulation, Autodesk, CFD

1. INTRODUCTION

Theoretical research CFD simulation method mainly aims to study the fluid flow in specific circumstances. CFD programs are recognized as an integral part of computing techniques CAE (Computer Aided Engineering) and is used in numerical analyzes, based on a set of mathematical expressions on linear complex equations defining fundamental fluid flow and heat transfer [1-6].

These equations are solved iteratively using complex algorithms incorporated into CFD programs. They allow carrying out research on the behavior of a fluid stream in a known geometric area [5, 6].

Methods of calculation and analysis of fluid dynamics, using specialized programs in the Computational Fluid Dynamics Analysis (CFD) simulation by enabling computers to fluid flow, heat transfer and associated phenomena, in which fluid flow phenomenon is predominant. Using CFD, provides the opportunity to achieve a faster and more thorough study of fluid flow processes and is an important step to obtain information that cannot be obtained otherwise [4-6].

Current commercial CFD codes, using three methods of spatial mesh structure are presented in Fig. 1.

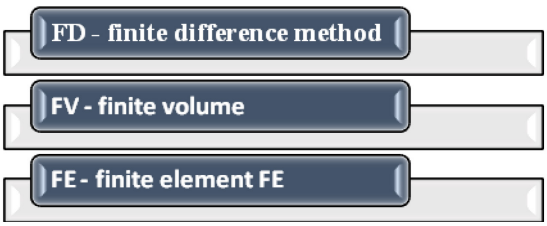

Figure 1. Three methods of spatial mesh structure for current commercial CFD codes

The finite element method is generally more accurate than the finite volume method, but finite volume method can achieve more accurate mass balances using the balance sheet continuity per volume control. Finite volume method is more appropriate when fluid transport, while the finite element method is used more in the calculations of tension or conduction, which satisfies local continuity condition, is of less importance.

The output of CFD programs can be viewed graphically by plotting velocity vectors color, contour pressure fields, fields with constant properties of the flow field, and are presented as numerical data and chart sin 2D or 3D system.

Autodesk Simulation CFD provides analysis functions fast, precise and direct innovative product development phase, where decision making is critical. CFD simulation extends Digital Prototyping concept for cooling equipment to the electronics, mechanical, industrial and consumer products [7, 8].
Typically, conducting any flow analysis involves several steps such as presented in Fig. 2.

Figure 2. Several steps in conducting the flow analysis

2. BERNOULLI'S LAW. EXPERIMENTAL TEACHING STAND

Fluid dynamics studies the motion of fluids and their interaction with rigid bodies, taking into account the forces involved and energy transformations produced during movement [1-6]. In fluid dynamics apply general principles of general mechanics, laws of variation and conservation laws.
To establish the necessary conditions Bernoulli additional fluid motion:

i. equation will determine the current line equations:

$$\frac{dx}{u} = \frac{dy}{v} = \frac{dz}{w} \tag{1}$$

ii. mass force field is a potential field, so:

$$X = \frac{\partial U}{\partial x}, \qquad Y = \frac{\partial U}{\partial y}, \qquad Z = \frac{\partial U}{\partial z} \tag{2}$$

the movement of the fluid the movement to be permanent, ie hydrodynamic parameters are not dependent on the time point, hence:

$$\frac{\partial u}{\partial t} = \frac{\partial v}{\partial t} = \frac{\partial w}{\partial t} = \mathbf{0} \tag{3}$$

iii. fluid the movement to be potential, ie velocity components can be expressed in terms of a potential $u = \frac{\partial \varphi}{\partial x}$, $v = \frac{\partial \varphi}{\partial y}$, $w = \frac{\partial \varphi}{\partial z}$, from which it follows that $\omega_x = \omega_y = \omega_z = \mathbf{0}$.

If you express the equation of motion given by Gromek-Lamb we introduce whirl vector components, we obtain the relations [1]:

$$\begin{cases} \frac{\partial u}{\partial t} + \frac{\partial}{\partial x}\left(\frac{V^2}{2} + \int \frac{dp}{\rho} + U\right) + 2(w\omega_y - v\omega_z) = 0 \\ \frac{\partial v}{\partial t} + \frac{\partial}{\partial x}\left(\frac{V^2}{2} + \int \frac{dp}{\rho} + U\right) + 2(u\omega_z - w\omega_x) = 0 \\ \frac{\partial u}{\partial t} + \frac{\partial}{\partial x}\left(\frac{V^2}{2} + \int \frac{dp}{\rho} + U\right) + 2(v\omega_x - u\omega_y) = 0 \end{cases} \quad (4)$$

Multiplying these equations by dx, dy, dz and adding, we get:

$$\frac{\partial}{\partial t}(udx + vdy + wdz) + d\left(\frac{V^2}{2} + \int \frac{dp}{\rho} + U\right) + 2\begin{vmatrix} dx & dy & dz \\ \omega_x & \omega_y & \omega_z \\ u & v & w \end{vmatrix} = 0 \quad (5)$$

If additional conditions imposed, the equation obtained is:

$$d\left(\frac{V^2}{2} + \int \frac{dp}{\rho} + U\right) = 0 \quad (6)$$

If we integrate this equation between two points within the current line or between any two points are in a moving current potential is obtained:

$$\frac{V^2}{2} + \int \frac{dp}{\rho} + U = C \quad (7)$$

where C is a constant value throughout the mass fluid.
The constant motion of fluids incompressible (ρ = const.) In the gravitational field (U = gz+ct.) the relationship becomes:

$$\frac{V_1^2}{2} + \frac{p_1}{\rho} + gz_1 = \frac{V_2^2}{2} + \frac{p_2}{\rho} + gz_2 \; sau \; \frac{V_1^2}{2g} + \frac{p_1}{\gamma} + z_1 = \frac{V_2^2}{2g} + \frac{p_2}{\gamma} + z_2 \quad (8)$$

If permanent movement virtually incompressible fluid taking place in a field of forces negligible mass ((fm≅0), so U = const.), the relationship is written:

$$\frac{V_1^2}{2} + \frac{p_1}{\rho} = \frac{V_2^2}{2} + \frac{p_2}{\rho} \quad (9)$$

Equation (9) is lighter fluid Bernoulli relationship (in case they can be considered to be practically incompressible) and the pressure at relatively low speed (for example, drawing in air to a carburetor, the air ducts), or to the liquid if the forces of gravity can be neglected compared to the forces of inertia and pressure forces (ie movement through the drive pressure showing no differences quota practically horizontal movement of water through small diameter pipes). In some cases the relationship can be written as:

$$p_1 + \rho\frac{V_1^2}{2} = p_1 + \rho\frac{V_2^2}{2} \quad (10)$$

where p is the piezometric pressure (also called static pressure), $\rho V^2/2$ is the dynamic pressure and the sum of $p + \rho V^2/2$ is the total pressure.
By doing dimensional analysis of the terms in equation (8), we see that each has dimensions of length, which allows a graphical representation of the entire expression.
Consider a horizontal reference plane OO chosen arbitrarily and DC current line, some, we choose three points M_1, M_2, M_3 which to plan coordinates z_1, z_2, z_3, and particles passing through these points are hydrodynamic parameters (v_1, p_1), (v_2, p_2), (v_3, p_3), Fig. 3.

Equality shows that the sum of the three segments z, p/γ, $v^2/2g$ must be the same for all points. The locus of points at the end segments (z + p/γ) PP line, called the piezometric line and the line EE, the design is horizontal and parallel to the OO so called energy lines or energy level.
Apply Bernoulli's relationship to the three points in the current line:

$$\frac{V_1^2}{2g} + \frac{p_1}{\gamma} + z_1 = \frac{V_2^2}{2g} + \frac{p_2}{\gamma} + z_2 = \frac{V_3^2}{2g} + \frac{p_3}{\gamma} + z_3 = Ct. \quad (10)$$

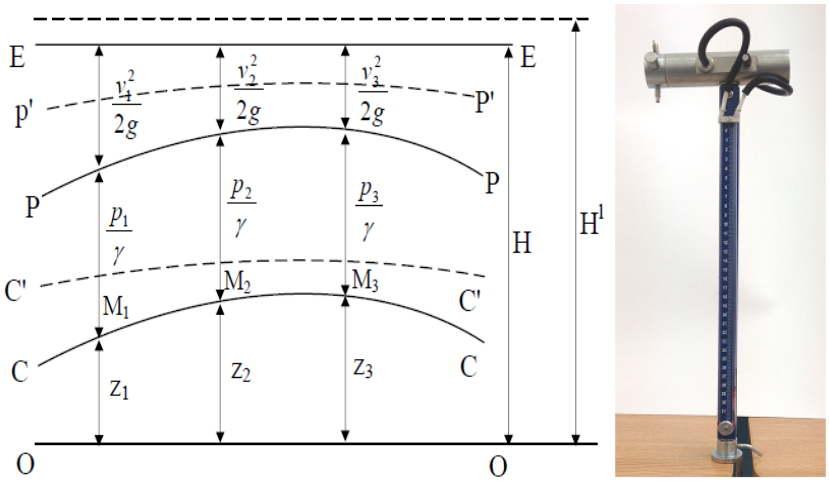

Figure 3. The energy lines and the measurement apparatus

Distance constant value of H plotted Bernoulli relationship varies from a current line to another. Another way to streamline denoted C'-C 'piezometric line is P'-P' and the constant has the value H'.
For the interpretation of the relationship Bernoulli energy, multiply particle weight m·g relationship, as follows:

$$\frac{mV^2}{2} + pV + mgz = ct. \quad (11)$$

The first term is the kinetic energy of particle, the second term represents the potential energy of pressure and the third is the potential energy of position.
It can be concluded that the fluid moving permanent forces arising from the mass potential, the amount of kinetic energy, potential energy, and the pressure potential energy of position remain constant for all the points located on the same power line.
The verification Bernoulli's law is an apparatus for the teaching of fluid mechanics. Outside verify Bernoulli's law, the device allows experimental phenomena and laws. This unit can be used as Prandtl Pitot tube or tube. It is designed to be used, preferably together with an ordinary vacuum cleaner.
Experiences that can be achieved with this device, and relative errors, passed in parenthesis are:

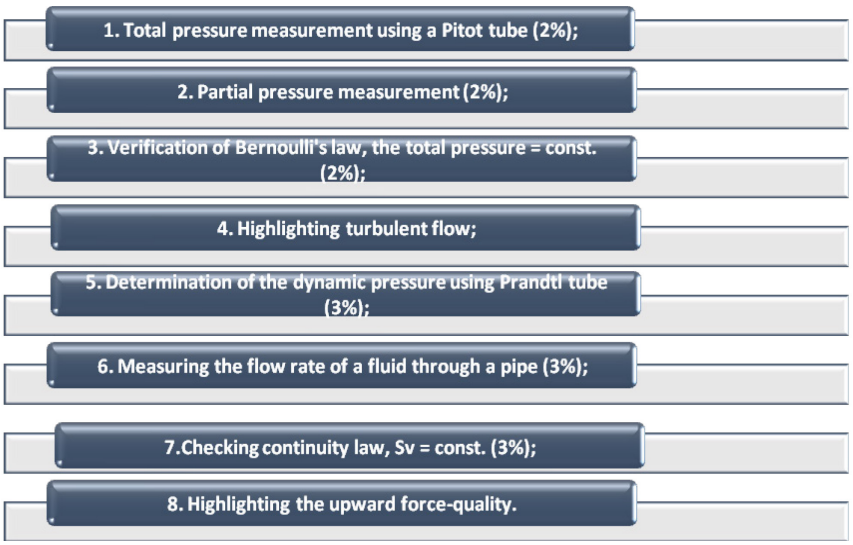

Figure 4. Achieved experiences and the errors

3. COMPUTERISED SIMULATION OFFLUID FLOWTHROUGH THE DEVICEPROPOSED

Replacing experimental research on real systems with theoretical modeling, virtual systems allowed a significant reduction of time and costs associated with development, design and manufacture of new types of installations. The steps of the simulation by CFD are described, in the followings.

3.1. Pre-processing

Configuring a problem solving model with CFD programs has three distinct steps:
- create or import 3D geometric model;
- creation of the mesh;
- physical configuration of the problem.

In geometric modeling, topology simulation model is established in the initial phase of designing geometric pattern with CAD programs [7-12]. At this stage the interaction interfaces are set solid and fluid main regions. For designing 3D geometric model of the device was used CATIA software [7, 8, 10].

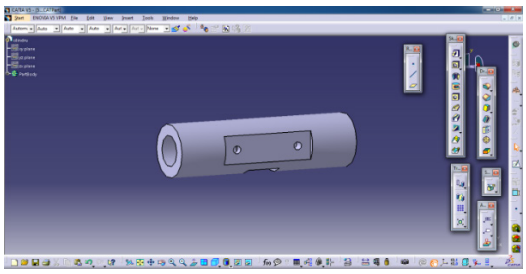

Figure 5. 3D device design using software CATIA V5

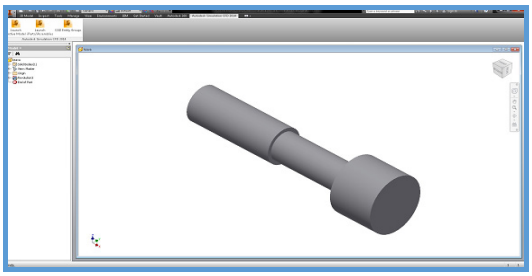

Figure 6. The interior of the device designed

Steps to create the network are:

i. delimiting regions geometric model (Fig. 6), in which case the tube design is presented;
ii. the choice of the working fluid which passes through tube design (Fig. 7) and the mesh area of the interior volume thereof (Fig. 8) by generating area network, and generating network volume. Spatial discretization of the domain must obtain seamless the network of spaces without introducing elements or cells with large deformations.

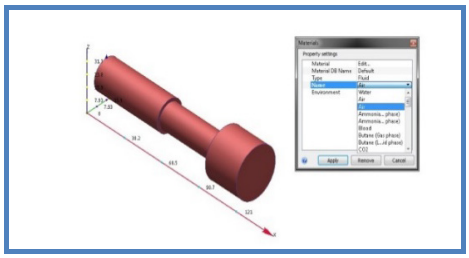

Figure 7. The choice of fluid

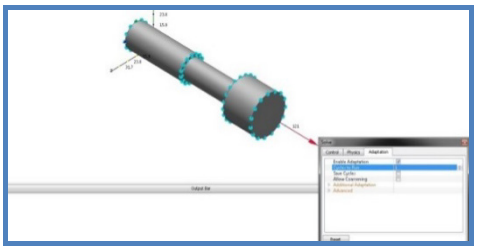

Figure 8. To mesh the volume

iii. setting boundary conditions by setting the direction off low of input and output parameters (Fig. 9).

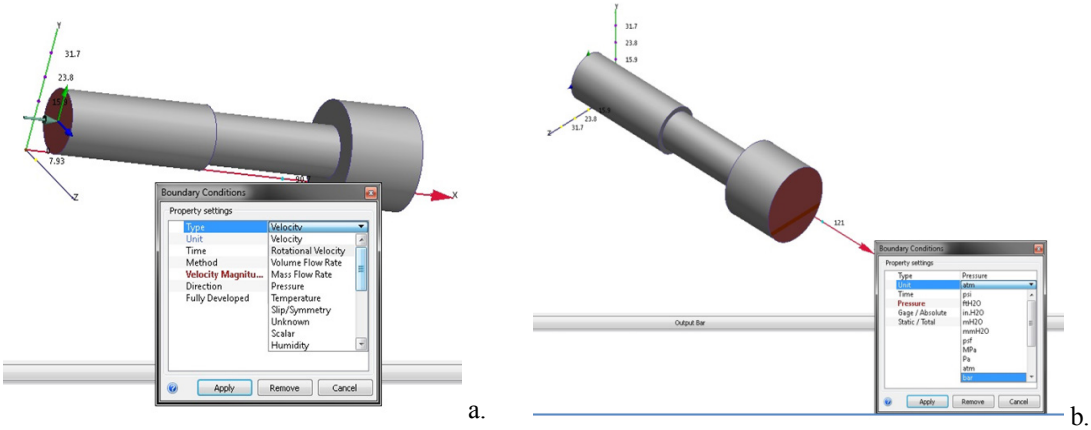

Figure 9. Setting boundary conditions. a) entry into the tube; b) the outlet tube

3.2. Solving CFD

The boundary conditions defined, the simulation can be performed. The last step in obtaining the desired data post-processing of data in the data sets necessary analyzes are taken from the simulation data.
To solve differential equations with partial derivatives, fundamental to conservation of angular momentum and scalar quantities (mass, energy or turbulence) CFD codes using an unobtrusive integration based on service volume control (Fig. 10).

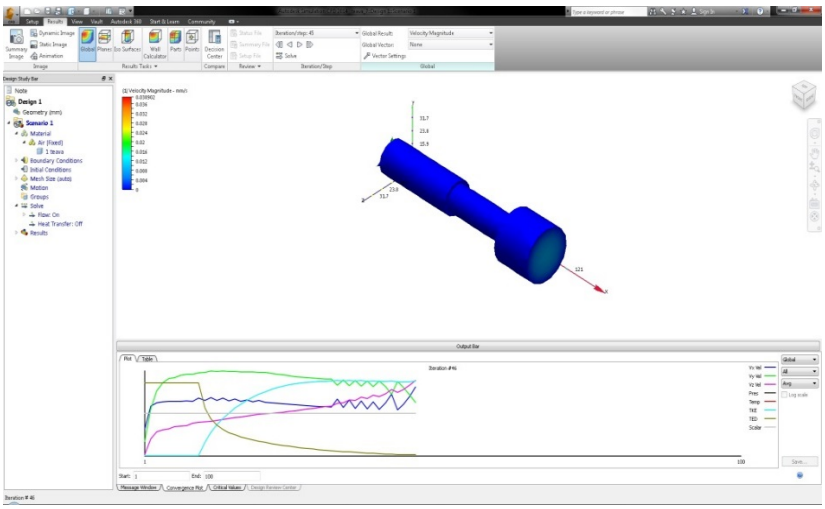

Figure 10. Integrating discrete based on technique of control volume

The calculation method has the advantage of reduced computational resource consumption and better approximates the entire volume control value, which is given by the central node, but the second method calculates the integrated value of the particular area where it is midway between the two nodes.
Finite volume method involves two levels of approximation values:

- calculating surface volume control variables-interpolation;
- calculating the volume and surface integrals-integration.

3.3. Post-processing

When numerical simulation reaches convergence, the final data set is stored as a final solution. This data set is the registration status of all elements in the model, speed, density, pressure, flow aspects, etc. In order to be interpreted the data, they must be ordered and reduced size understandable.
This data display is called post processing and simulation makes it possible to compare current data with data from other simulations or external data, e.g. from experimental research (Fig. 11, Fig. 12).

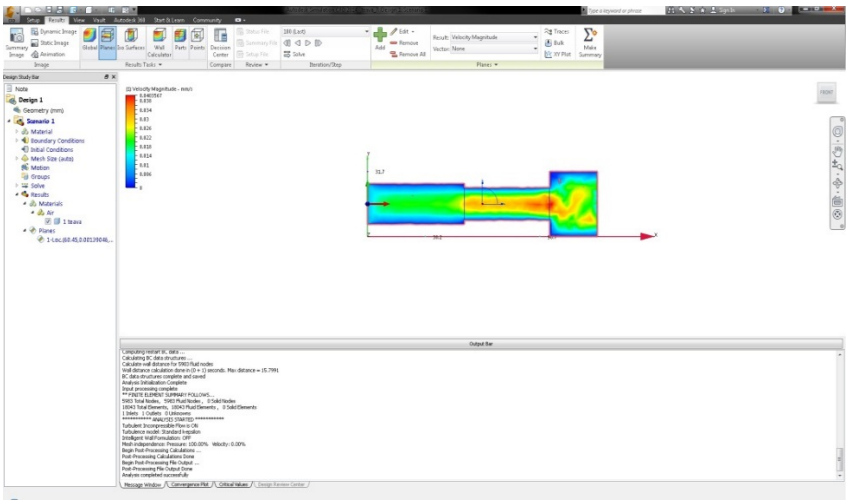

Figure 11. The velocity field

There are many ways to display the data, so it is important to make a selection of data representation to compare them with other data sets.
The standard viewing options available are the contour plots of the velocity vector.

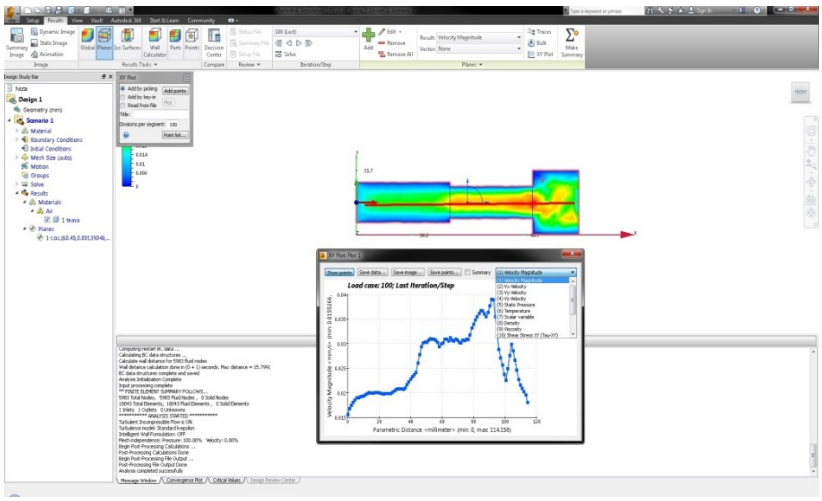

Figure 12. Distribution speed in mm/sec along the length of the device designed

4. CONCLUSIONS

This paper presented a stand that allow teachers:

- ✓ total pressure measurement using a Pitot tube;
- ✓ measurement of the partial pressure;
- ✓ verification of Bernoulli's law, the total pressure= ct.;
- ✓ highlighting the turbulent flow; determining dynamic pressure using Prandtl tube;
- ✓ measuring the flow rate of a fluid through a pipe (3%);
- ✓ check continuity law, Sv=ct.(3%); the upward force-quality evidence.

With Autodesk CFD software were presented are the steps to simulate the flow inside the tube current, checking Bernoulli's law. The equations are solved iteratively using complex algorithms incorporated into CFD programs. They allow carrying out research on the behavior of a fluid stream in a known geometric area.

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